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THE RELATIONSHIP BETWEEN COGNITIVE STRATEGY TRAINING AND PERFORMANCE ON TASKS OF READING COMPREHENSION WITHIN A LEARNING DISABLED GROUP OF CHILDREN

by

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A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled, "The Relationship Between Cognitive Strategy Training and Performance on Tasks of Reading Comprehension Within a Learning Disabled Group of Children", submitted by Anne Brailsford in partial fulfilment of the requirements for the degree of Master of Education.

ABSTRACT

The relationship between cognitive strategy training, as conceptualized within the framework of the simultaneous-successive model of information processing (Das et al, 1973 a , 1973 b , 1975, 1979 a , 1979 b), and reading comprehension was explored in the present study. The purpose of this study was to determine the efficacy of a remedial strategy training programme in improving performance on simultaneous and successive information processing tasks, and also on tasks of reading comprehension.

A group of twenty-four, nine to twelve year old learning disabled children, enrolled in reading resource room programmes at two schools, was selected for this study. The children scored above I.Q. 85 on the non-verbal section of the Canadian Cognitive Abilities Test (1974), and below the 35th percentile on the comprehension sub-test of the Gates-MacGinitie Reading Test, Level D (1978). Students were assigned to either Experimental or Control Groups, so that each group was composed of twelve children, six from each of the two participating schools. Both groups contained eight boys and four girls. No significant pre-test differences between the groups were obtained for age, I.Q. (Canadian Cognitive Abilities Test), and reading comprehension (Gates-MacGinitie).

A pre-test battery, consisting of simultaneous and successive tests, test of reading comprehension and tasks to

measure the speed of processing, was administered to each member of both groups. Reading comprehension was assessed quantitatively, in terms of reading grade equivalent scores (Gates-MacGinitie) and reading instructional levels (Standard Reading Inventory), and also qualitatively by analyzing the nature of information contained in the children's story recalls (Protocal Analysis; Fagan, 1980). The Experimental Group received fifteen hours of remediation in the task-appropriate utilization of simultaneous and successive information processing strategies. The Control Group received fifteen hours of remedial reading instruction within the resource room programmes at the two schools. Both the Experimental and Control remediation programmes were conducted with small groups of children. At the conclusion of the intervention phase, a post-test battery, replicating the composition of the pre-test battery, was administered to examine the effectiveness of remediation.

Significantly better Experimental, than Control Group, performance on all the successive tests and one test of simultaneous processing was attributed to the cognitive strategy training programme. The Experimental Group obtained significantly higher instructional reading levels (Standard Reading Inventory) than the Control Group, at post test, and this improvement was viewed as a demonstration of the effectiveness of intervention. In a qualitative analysis of the children's recalls of stories, no significant group

differences were observed. However a descriptive overview of the results illustrated an Experimental Group trend towards the increased production (Pre/Post) of inferences, summaries and syntheses, and a Control Group trend towards the increased production of erroneous information and vague generalizations. It is apparent that, in order to offer further clarity on the nature of readers' recalls of stories, larger numbers within the groups are necessary.

The findings of this study suggest the viability of isolating educationally significant sub-groups from within a learning disabled population, and analyzing task failure in terms of the processing demands placed on the child. This study has isolated a group of 'poor readers' and examined the task of reading comprehension in terms of the information processing demands placed on the reader. The results support the efficacy of structuring a cognitive strategy training programme, embedded in the simultaneous-successive model, for improving the reading comprehension performance of learning disabled children experiencing reading failure.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

> The ability to read well is one of a person's most valuable achievements. Our world is a reading world. It would be difficult to find any activity, whether in school, in the home, on the farm, in business, in the professions, or even in recreational pursuits that does not require at least some reading ability. Often reading is an indispensable channel of communication with an everwidening world (Bond, Tinker and Wasson, 1979, p. 3).

Most people in our society today would agree with Bond, Tinker and Wasson's (1979) statement. Although early in the nineteenth century societal literacy may have been defined as reading one's name, or reproducing the letters to write one's signature (Resnick and Resnick, 1977), this literacy criterion is not considered satisfactory today. Bryan and Bryan (1978) describe the "forces of change" (p. 4) in the second half of the twentieth century, with technological advances demanding more training and education in general, and more effective reading in particular. They comment that, "The future of a child within this society who cannot read is very dim" (Bryan and Bryan, 1978, p. 4). Societal concern for literacy has been reflected in the proliferation of research, specialized education programmes, and parental

and professional organizations focusing on the child experiencing difficulties with learning academic skills, and especially with learning to read.

This study concerns itself with investigating the reading comprehension difficulties of grades four, five and six children, whose lack of reading proficiency is not explicable in terms of low general intelligence, sensory impairments, nor diagnosed neurological damage. Reading comprehension, or the reconstruction of meaning from print (Goodman, 1970 a, 1970 b), is the goal of reading and hence is the focus of the investigation. Silent, rather than oral, reading comprehension is selected for study for two major reasons. Firstly, as early as 1881, Farnham recognized the primacy of silent reading:

> ... silent reading is the fundamental process ... oral reading, or "thinking aloud", is entirely subordinate to silent reading. While oral expression is subject to laws of its own, its excellence depends upon the success of the reader in comprehending the thought of the author (From: Resnick and Resnick, 1977, p. 381).

Secondly, the goal of independent, fluent reading is to be able to reconstruct meaning from silently read materials. In the upper elementary grades the child is expected to read texts silently, and the focus of instruction has traditionally changed from oral to silent reading (Bond, Tinker and Wasson, 1979). Thus, the study's emphasis on silent reading comprehension would seem salient for grades four to six children.

Children with reading difficulties have been exposed to a vast array of specialized intervention programmes over the past twenty years. Techniques have ranged from the task-analytic approach of teaching component sub-skills of reading (Engelman and Osborn, 1970), to the ability training approaches that emphasize the training of modality-specific perceptual process (Kephart, 1960; Frostig, 1967). Spache (1976 a), in a comprehensive review of strategies and programmes for remediating reading difficulties, observes:

> There is no one best approach to remediation, and even among these approaches there is very little evidence of any hierarchy of effectiveness (p. 279).

An alternate approach to remediation of comprehension difficulties is envisaged in this study. Luria's (1966 a , 1966 b , 1973) research on brain damaged patients revealed the integrative nature of the human brain, and the availability of simultaneous and successive processes for coding information. Das et al (1973 a , 1973 b , 1975, 1979) encapsulated Luria's theories within their model of simultaneous and successive processing. The model suggests a theoretical framework for conceptualizing human information processing, and as such provides a dynamic structure for investigating the reader as a processor of printed information. Research has isolated simultaneous and successive processes as "psychological realities" (Leong, 1971, p. 335), and it is suggested that these processes are available, to varying

extents, to the reader involved in tasks of reading comprehension. This study investigates the efficacy of structuring a remediation programme, embedded in the theoretical framework of the simultaneous-successive model, with the objective of improving reading comprehension by training cognitive information processing strategies. Such an intervention programme emphasizes training in the task-appropriate utilization of simultaneous and successive processes, and focuses on assisting the child to learn how to form strategies for information processing.

CHAPTER TWO

THEORETICAL CONSIDERATIONS AND RELATED LITERATURE

Movement Towards a Relatively Homogeneous Group of 'Poor Readers' Within a Learning Disabled Population

Since traditional definitions of learning disabled children have been too general and all encompassing there is a movement to describe and operationalize sub-groups of children with particular learning difficulties. Identification of a relatively homogeneous group of children with reading comprehension difficulties is the approach utilized in the present study.

Functional terminology and descriptive classification systems are intended to facilitate communication within the fields of research and education (Bryan and Bryan, 1978) and can provide a bridge for conceptual understanding between theory and practice. However, as yet, definitions of learning disability have not served to clarify communication, partially due to differences in theoretical perspective between the researcher and the educator. Keogh (1977) has suggested that the differences in philosophical approach have resulted in a

dichotomous case of "mild schizophrenia" (p. 478) with researchers and educational clinicians pursuing different avenues and adopting stances that prioritize areas as divergent as the etiological factors underlying the learning difficulties of the child and remediation schemes that focus on a particular skill or process. An operational definition has also been elusive due to the lack of a consistent core of characteristics within a heterogeneous population of children experiencing learning difficulties (Larsen, 1976, Myers and Hammill, 1976; Senf, 1977; Satz, Taylor, Friel and Fletcher, 1978; Fletcher and Satz, 1979; Reger, 1979).

Since Kirk's (1963) coinage of the term 'learning disabled', the label has escalated in application to refer to a variety of children who appear to need the services of specialized education in order to learn. The United States National Advisory Committee on Handicapped Children's definition of learning disability was used in the 1969, Children with Specific Learning Disabilities Act (P.L. 91-230), and later incorporated into the 1975, Education for All Handicapped Children Act (P.L. 94-142):

> The term "children with specific learning disabilities" means those children who have a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which disorder may manifest itself in imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations. Such disorders include such conditions as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, and developmental asphasia. Such term does not include

> children who have learning problems which are primarily the result of visual, hearing, or motor handicaps, of mental retardation, of emotional disturbance, or of environmental, cultural, or economic disadvantage (Kirk and Gallagher, 1979, p. 282).

This definition has become widely used throughout North America (Myers and Hammill, 1976; Gearheart, 1977; Kirk and Gallagher, 1979). Gillespie, Miller and Fielder (1975) reviewed the definitions of learning disabilities, utilized in all fifty of the U.S. states, and observed that two thirds of the states used the federal definition, though with some adaptations. Modifications included prioritizing neurological factors, or utilizing specific tests to operationalize aspects of the definition for funding and placement purposes. Other definitions of learning disabled children have emerged in the last two decades (Myklebust, 1963; Chalfant and Scheffelin, 1969; Critchley, 1970; Chalfant and King, 1976), and though their emphases and phraseology may differ they do include two common features. The definitions include a discrepancy factor, emphasizing the imbalance between the learning disabled child's intellectual potential and his actual school achievement. They also include exclusion criteria, by which children categorized as mentally retarded or sensorily impaired may not be considered as primarily learning disabled, though indeed they may be considered learning disabled in addition to their primary handicap, and hence require multiple services (Chalfant and King, 1976). Such definitions have stimulated criticism

from those who question the efficacy of assessing an abstract 'potential' via traditional intelligence tests (Bryan and Bryan, 1978; Gearheart, 1977), and those who are concerned that the exclusion clauses may deny services to minority groups (Bryan and Bryan, 1978; Myers and Hammill, 1976). The definitions have also been criticized for their lack of operational utility (Kauffman and Hallahan, 1976; Cohen, 1976). If there is a discrepancy observed between achievement and estimated potential how much of a discrepancy is significant, and as such would enable the child to receive special education services?

The state of the art in defining a learning disabled population is such that we can encounter definitions that are so general that all children, "who are not achieving scholastically, for whatever reason" (Phil, 1975, p. 20), are included. Perhaps the inherent danger in our present definitions is that, in most cases, learning disabilities have been so loosely conceptualized. In defining the learning disabled child we tend to offer the presupposition that this child shares a broad base of commonality, with any other child similarly named. Equally misleading is the assumption that there may be an underlying cause implicit in the joint classification, just as similarity in decibel loss in auditory acuity may classify the hearing impaired child. However, though the definitions suggest that a homogeneous group of learning disabled children may indeed exist, known classification systems have failed to

isolate the group. Present research suggests that homogeneity and unitary causation are fallacious conceptualizations (Valtin, 1978-79; Fletcher and Satz, 1979; Reger, 1979; Kirk and Gallagher, 1979). A learning disability, rather than being an isolated phenomenon, seems a more viable concept when aligned with the other complexities of human behaviour which are multifaceted and multiply causal in origin:

> Even a casual historical perspective suggests that the unidimensional, single-factor trait discrepancy model of learning disability never will result in a satisfactory definition. Human behavior is multidimensional; each dimension interacts with every other dimension, and these are in constant interaction with multienvironmental factors (Reger, 1979, p. 530).

Taylor, Satz and Friel (1979) support the multivariate conceptualization of learning disabilities, and suggest the utility of clarifying, "meaningful subgroups" (p. 99), grouped on performance variables and common features emerging from test profiles. Hence it would be simplistic to assume that definitions outlining a specific unitary core of characteristics could be adequate to describe and delineate a learning disabled population.

Researchers (Yule and Rutter, 1978; Eisenberg, 1978; Doehring, 1978; and Fletcher and Satz, 1979) have begun to elucidate and describe subgroups with the purpose of helping, "the clinician establish a prognosis and preferred treatment for each child" (Taylor, Satz, and Friel, 1979, p. 100). Meanwhile educational assistance programmes, established to

provide services for learning disabled children, continue to define their populations on loose classification systems and conceptualizations. Kirk and Elkins (1975), in a project sponsored by the United States Office of Education, reviewed the programmes and the characteristics of the children enrolled in the federally funded Child Service Demonstration Centers for Learning Disabilities. They reported that two-thirds of the work of the centers, across twenty-one states, was focused on remediating reading difficulties. Lerner (1975) has reported that the most common academic difficulty emerging in the classroom is the child who is experiencing problems with reading. The child's needs are often served within a local learning disabilities' resource room (Kirk and Elkins, 1975). Local school districts have determined their own definitions of resource room populations on the broad basis of provincial funding and the more specific criterion of parental interest in securing specialized reading intervention programmes for their children. Hence remediation programmes to assist the learning disabled may be quite synonymous with remedial reading programmes in many areas. Lerner (1975) suggests that presently we have two frameworks within which to consider children's reading difficulties, specifically, remedial reading and learning disabilities. She presents a case for 'synergizing', or synthesizing the two areas into the same conceptual framework, noting that both remedial reading teachers and learning disabilities resource teachers appear to deal with the same children encountering

similar difficulties with reading:

> ... most reading specialists in schools report that the greatest portion of their time and effort is spent in teaching children with reading problems, ... (p. 129).
> ... while the field of learning disabilities is concerned with many kinds of learning disorders learning disabled teachers report that reading is the most frequently encountered problem among school age children (p. 129).

Other researchers and educators support this educational synthesis, and stress the need for interdisciplinary co-operation (Myers and Hammill, 1976; Wallace, 1976; Wong, 1979). Myers and Hammill (1976) propose that until, "a satisfactory definition emerges" (p. 10), or more appropriately a cluster of meaningful sub-definitions, educators and researchers should identify children with specific disorders, for example reading difficulties, on the basis of operational clinical criteria with the objective of providing useful plans for remediation.

A common feature of definitions of learning disabled children is an indication of unexpected task or subject failure in at least one academic area (Chalfant and King, 1976; Rourke, 1978). The characteristic of failure to acquire expected facility in reading appears to be a relatively homogeneous attribute amongst children registered in centres and resource rooms established for the learning disabled (Kirk and Elkins, 1975; Learner, 1975). Rutter (1978), in an attempt to isolate educationally useful sub-groups, distinguishes two types of

reading disability which he describes respectively as displaying 'general reading backwardness' and 'specific reading retardation' (Rutter and Yule, 1975; Rutter, 1978). The group delineated as generally backward displays low achievement in reading and tends "to be of well below average intelligence" (Rutter, 1978, p. 15). Children with specific reading retardation have low achievement in reading, but have "a mean IQ which is roughly average for the general population" (Rutter, 1978, p. 15), and hence their reading difficulties cannot be attributed to low general intelligence. Rutter and Yule (1975), as a result of their epidemiological studies in London and the Isle of Wight, suggest that children with specific reading retardation are more likely to be boys (a ratio of around three or four to one), though within the general backwardness group the sex distribution appears to be almost equal. Compared to the general backwardness group the specific retardation group displays difficulties with speech and language but is less likely to demonstrate developmental motor problems or neurological disorders. Children described as 'backward' are more likely to come from, "socially disadvantaged homes" (Rutter, 1978, p. 16). Rutter (1978), recognizing that the specific reading retardation group is far from being homogeneous, makes a plea for further research to investigate, "finer sub-division" (p. 17), with the purpose of providing information that may be useful in planning appropriate remediation.

Rutter's research and resultant groupings are conceptualized within a synergistic framework, and provide a utilitarian stepping stone to investigating the child who is delineated as having reading difficulties that "are not explicable in terms of (his) general intelligence" (Rutter, 1978, p. 15). The present study focuses on the specific group of learning disabled children who have reading comprehension difficulties. In order to determine the nature of the reading comprehension problems experienced by this group of children a detailed examination of the reader and the reading process is appropriate.

The Reader as an Information Processor

> And so to completely analyse what we do when we read would almost be the acme of a psychologist's achievements, for it would be to describe very many of the workings of the human mind, as well as to unravel the tangled story of the most specific performance that civilization has learned in all its history (Huey, 1908, p. 6).

More than seventy years ago Huey recognized the inseparable link between the child as a reader and the child as a processor of information. In the same era Thorndike (1917) wrote an article, "Reading as reasoning", identifying reading as an active thinking process. He described the reader as a problem solver, "selecting the right elements of the situation and putting them together in the right relations" (p. 329), and using his mind to, "select, repress, soften, emphasize, correlate and organize" (p. 329). Though terminology may have changed over the years, Thorndike's concept of

the reader as an active thinker or processor is still timely and viable, and researchers are still attempting to "unravel the tangled story" (Huey, 1908, p. 6), to discover how the human mind processes and comprehends written materials.

Within the past two decades human information processing theory has encapsulated the metaphor of the reader as an information processor, the primary function of his mind being "to seek, select, acquire, organize, store, and at appropriate times, retrieve and utilize information about the world" (Smith, 1975, p. 2). In order to comprehend, or make sense of an author's message, the reader is involved in processing print, actively selecting, coding, storing and retrieving information from the reading material and from his own cognitive structure. Pearson and Johnson (1978) describe the interaction between 'inside the head' and 'outside the head' factors in reading comprehension. The 'inside' factors are the dynamic elements of the reader's cognitive structure, his knowledge of language, his prior experience with the subject matter, his intrinsic motivation and his "accumulated reading ability" (p. 9). The 'outside' factors are the textual components within the printed material, the familiarity of the words and the textual organization and readability, together with the atmosphere or quality of the "reading environment" (p. 10). Pearson and Johnson (1978) stress the interaction and interdependence of the 'inside' and 'outside' factors. Anderson (1978) and Doehring and Aulls (1979) support their

conceptualization of reading comprehension as emerging from an interaction between the reader's knowledge structure and the printed message structure. Smith (1975) suggests that the reader's knowledge structure is fluid and dynamic, constantly evolving through contact with the world, and that good readers may be distinguished not only by the amount of knowledge they possess but by "the degree to which they have it integrated and available for use" (p. 11): namely by the quality of their information processing strategies, and the facility by which they can achieve a 'match' between their knowledge and the author's information.

An Analogy

> The means whereby information about the environment is transformed into complex patterns of thought and those patterns changed into behavior has long been the primary target of psychological theories. The development of information theory in the late 1940's and later the advent of modern computer systems has strongly affected many new developments in theoretical psychology. It is becoming increasingly popular to view the human as functioning like the computer, as a complex information processing device (Rumelhart, 1977, p. 1).

Though the analogy may be mechanistic and somewhat simplistic the terminology and conceptual framework for considering the human mind as a complex, integrated processor is embedded in modern cognitive psychology and reading research. The input data for reading is not key punched holes on a card

but textual, printed material usually presented on a page. The computer, programmed to transform the input in a series of stages, has been loosely compared to the human mind's covert selection, coding and organization of reading material. The product, or computer output, is printed on sheets to be read by the programmer, whereas the product of reading comprehension may be available and observable in the form of the reader's recall of stories read or answers to questions. Though the analogy of the human mind as a processor is a useful and descriptive conceptualization in which to embed theories of the reading process there is an obvious limitation. The input and product of reading comprehension may be observable but the process involved is neither overt nor readily available for analysis. Only through the input and product can the researcher make inferences concerning the processing strategies of the reader. We cannot directly observe the mental activity involved in reading.

Information Processing Theories of Reading

Within the computer metaphor and the terminology of human information processing theory, researchers have attempted to conceptualize the reading process. The theories can be grouped into two broad frameworks within which reading is either viewed as a 'top-down' or 'bottom-up' processing activity. 'Top-down' theorists (Smith, 1971, 1975; Goodman, 1970 a 1970 b , 1976; and Anderson, 1978) view reading as a "conceptually driven process" (Anderson, 1978, p. 69), with the reader

'sampling' the print to confirm or reject hypotheses about the subject matter. Rumelhart (1977) describes 'top-down' processing as:

> A processing strategy in which one proposes possible inputs and then determines whether or not these inputs may in fact be present in the input data (p. 293).

Thus the reader's expectations, emerging from prior linguistic and conceptual knowledge, serve as preliminary processors to facilitate comprehension. 'Bottom-up' theorists (Gough, 1972; La Berge and Samuels, 1974; and Estes, 1977) describe reading as primarily "stimulus driven processing" (Rumelhart, 1978, p. 278) with analysis proceeding "from the most primitive low-order level to the most complex high-order level" (Anderson, 1978, p. 69). Within this framework reading is assumed to progress from analysis of letter features and letter clusters, to analysis of words, words strings and sentences. At each level phonological associations are made and word meanings are accessed from the reader's word knowledge, or lexicon, until eventually semantic understanding of a sentence is achieved.

The 'Top-Down' Theory of the Reading Process

Within the 'top-down' theoretical perspective the reader is viewed as a problem solver, using his conceptual knowledge of the world to form hypotheses about what is being read and analyzing the data or print to confirm or adjust

the hypotheses. A complete analysis of print is not considered prerequisite, or indeed necessary, for comprehension of what is read. The direction of processing is thus "from the cognitive system downward" (Levy, 1978, p. 144), with the reader's conceptual knowledge, incorporated into his dynamic cognitive structure, assuming an executive control in the reading process.

The reader's knowledge is conceptualized as being incorporated into a schematic framework or abstract structure (Piaget, 1926; Bartlett, 1932; and Anderson, 1978). A schema is viewed as a global, inclusive structure that represents commonalities and relationships amongst a class of events or objects, containing slots or placeholders as instances or examples of a holistic concept (Anderson, 1978). A 'human body schema' would provide, for example, placeholders for legs, arms, head and other detailed body components. The slots contain the information by which we recognize specificities within the whole, and the schema provides the relationships amongst the parts to allow a global understanding of the whole.

Schema theory has been applied to reading research. Comprehension of sentences is assumed to be facilitated by the reader generating a conceptual schema or a relevant context for the subject matter. Bransford and Johnson (1973) presented anomalous sentences to subjects, e.g. "The notes were sour because the seams split" and "The haystack was important because the cloth ripped" (p. 404). Though the individual

words were easy to read and the syntax was clear, each sentence seemed incomprehensible to most readers. However when global schemas, or high-order context clues were provided, i.e. "bagpipes" for the first sentence and "parachute" for the second sentence, the subjects were able to recall the sentences, from memory, more easily. Presumably the readers were then able to activate a conceptual framework and the key words in the sentences could fill placeholders, thus clarifying the problem and making the sentences meaningful. Bransford and Johnson concluded, "that semantic anomaly is largely a function of the degree to which one can relate a sentence to some relevant aspect of his (the reader's) knowledge of the world" (p. 405).

Usually the reader is required to comprehend ideas within paragraphs and longer discourse. Bransford and Johnson (1973) presented readers with ambiguous paragraphs and asked them to recall the subject matter and respond to comprehension questions. For example a section of one paragraph read:

> The procedure is actually quite simple. First you arrange things into different groups. Of course, one pile may be sufficient depending on how much there is to do. If you have to go somewhere else due to lack of facilities that is the next step, otherwise you are pretty well set. It is important not to overdo things. That is, it is better to do too few things at once than too many. In the short run this may not seem important but complications can easily arise (p. 400).

As in the anomalous sentences the syntax was clear and the words were simple, but the paragraph was not clearly understood by

the readers, who produced poor recalls and low comprehension scores. When a title, or globally inclusive concept, was provided, in this case 'washing clothes', the reader's recalls and comprehension scores demonstrated significant improvement. 'Washing clothes' had activated schemas from prior knowledge, and hence events and objects outlined in the paragraph, could occupy relevant placeholders. The readers' activation of a conceptual framework enabled them to understand the relationships amongst the actions, situations and things in the paragraph, and hence comprehension was facilitated.

Smith (1971, 1975) views reading as a 'top-down' process with the reader focused on making sense of printed material, through maximal use of his conceptual and linguistic knowledge and minimal use of graphic analysis.

> Fluent reading entails two basic skills. ... The first skill is the prediction of meaning and the sampling of surface structure to eliminate uncertainty. ... The second skill is the ability to make the most economical use of possible visual information (Smith, 1975, p. 185).

The 'sampling' of text, to Smith, has the purpose of confirming or adjusting the reader's hypotheses. It includes relevant attention to graphic, syntactic and semantic features, but not phonological analysis. Decoding words into sounds, he observes, is "only possible through the intermediary of meaning. In other words, it is only by understanding what you read that you can read aloud, or to yourself" (1975, p. 180). By asking

children to recognize isolated letters, letter clusters or words removed from context, a situation of maximum uncertainty is presented. Reading is subsumed within Smith's conception of the child's goal of making sense out of his world (Smith, 1971, 1975), and this meaning - seeking in the sense of predicting and testing hypotheses on the basis of acquired knowledge, precedes any minute analysis of letters, words or phrases.

Goodman (1970 a , 1970 b , 1970 c) also views reading as being largely a "conceptually driven process" (Anderson, 1978, p. 69), with its purpose being "the reconstruction of meaning" (Goodman, 1970 a , p. 5).

> Meaning is not in print, but it is meaning that the author begins with when he writes. Somehow the reader strives to reconstruct the meaning as he reads (p. 10).

Reading, Goodman observes, is a "psycholinguistic guessing game", involving "an interation between thought and language" (1970 b , p. 260). The reader reconstructs meaning by predicting likely events, and selecting the fewest and most relevant cues from the text to test the predictions. Goodman (1970 a , 1970 b) suggests that the cues may be graphic, phonic, syntactic and semantic, and that the skilled reader is never bound by exact perception and identification of all the textual elements. Goodman differs from Smith (1971, 1975) in that he conceptualizes the beginning reader recoding the graphic information into internal or oral speech, using his

own speech as aural input and decoding (comprehending) as he listens. The proficient reader, however, reconstructs meaning directly and immediately from the "graphic input" (1970 b , p. 18), with the supplementary use of speech recoding when he finds it helpful.

> In silent reading, the reader sweeps ahead sampling from the graphic input, predicting structures, leaping to quick conclusions about the meaning and only slowing down or regressing when the subsequent sampling fails to confirm what he expects to find (1970 a , p. 19).

Meaning, to Goodman, is the goal of the reader, who constantly checks to confirm that what he is reading is consistent with his predictions, sampling the fewest cues necessary to achieve his goal.

The 'Bottom-Up' Theory of the Reading Process

Theorists operating from the perspective of a 'bottom-up' view of the reading process assume that the reader analyzes the stimulus data, or print, and processes the information through a series of low-level to high-order stages (Samuels, 1970; Gough, 1972; La Berge and Samuels, 1974; and Estes, 1977). The textual information is transformed by the reader's "visual, phonological and episodic memory system until it is finally comprehended in the semantic system" (La Berge and Samuels, 1974, p. 293). Reading is viewed as "primarily a process of sifting sensory information through a succession of levels of memory comparisons" (Estes, 1977, p. 22). The

sensory stimuli are analyzed in terms of the visual features that comprise letters, e.g., horizontal, vertical and oblique strokes, and closed and open loops. Subsequent perceptual, phonological and morphological analysis allows the reader to generate meaning from words, word clusters and sentences. The emphasis is placed on building an analytic bank of component sub-skills that enables the reader to accumulate an accurate and automatically recalled store of textual information. When the lower orders of the hierarchical filter system, i.e., letters, letter clusters and words, are automated the information processing system of the reader is available for comprehension (La Berge and Samuels, 1974). Thus "it is assumed that the efficiency of the good reader's lower-level stimulus-analysis processes free capacity for higher-level processes" (Stanovich, 1980, p. 36).

Within this framework the reader is not viewed as a hypothesis-tester, but as an analytic processor of print. Gough (1972) emphasizes,

> ... the Reader is not a guesser. From the outside, he appears to go from print to meaning as if by magic. But I have contended that this is an illusion, that he really plods through the sentence, letter by letter, word by word. He may not do so; but to show that he does not, his trick will have to be exposed (p. 354).

Gough (1972) assumes that the reader perceives the visual stimulus of print and associates images with individual letters and then letter strings. Coding of the letters to reach

meaning could proceed visually and directly, or through an intermediate phonological stage. However Gough contends that neither of these routes is accurate, and that the letters are possibly coded into abstract phonemic structures by means of phonological rules, and these abstractions provide access to the lexicon or word store. The reader then searches his lexicon, recovers a meaning for each word, stores the word and its association in memory, and finally a sentence emerges complete with its semantic referents. Gough observes that slow decoding from the perception of letters through to lexical access can cause deterioration in comprehension, as memory for stored words will decay before semantic interpretation takes place.

Estes (1977) notes the reliability of "the hierarchically organized critical feature-letter-word filter system" (p. 23) in that it does not deny that other sources of information may be available to the reader, but it does select "sensory information largely independently of the context and thus enables the reader 'to see what is there' regardless of his prior expectations" (p. 23). Estes (1977) observes that the system is accurate and textually constrained, providing "an almost fail-safe mechanism" (p. 23) for the reader to respond to print in any context or circumstance. Samuels (1970), though noting the importance of context as a secondary cueing device, stresses the primacy of graphophonic analysis for reading accuracy:

> While context provides an important cue for recognition and for learning to read a word, it is important to determine if the reader can recognize a word when it is presented in isolation. If the student does not usually attend to the stimulus when he says the word, he may not learn to read it (p. 270).

La Berge and Samuels (1974) observe that efficient reading is the result of accurate and then automatic processing at all stages of transforming text from visual information to meaning. At the level of accuracy the reader utilizes attention for processing graphophonic information, but when the automatic level is achieved, attention to basic coding is not viewed as being necessary, and the reader can progress to higher level processing. Reading is thus viewed as being the co-ordination of many lower order subskills or components, automaticity of which leads to success with the complex skill of comprehension. La Berge and Samuels (1974) view perceptual attention, selection and discriminant analysis of letters, letter groups and words, as a primary subskill, i.e., "learning of a graphemic code" (p. 297). Recognition of graphemic features allows direct access to the reader's word lexicon, or activation of phonological recoding, and then access to the meaning code. The goal of skilled reading is that "the reader can maintain his attention continuously on the meaning units of semantic memory, while the decoding from visual to semantic systems proceeds automatically" (La Berge and Samuels, 1974, p. 313).

Automaticity in lower level processing allows the reader's limited attention capacity to be focused on comprehension (La Berge and Samuels, 1974; Perfetti and Hogaboam, 1975; Lesgold and Perfetti, 1978; Curtis, 1979). Conversely, attention directed largely to processing at the graphemic and phonological levels implies that adequate attentional capacity may not be available for processing at the higher semantic levels. The beginning reader, and the poor reader, may be giving primary attention to graphophonic analysis, and hence little attention is directed towards higher level processing. It is suggested that the reader's information processing may operate on a time-sharing basis with attention alternating "between recognizing words and integrating sentence ideas into memory" (Lesgold and Perfetti, 1978, p. 325). Curtis (1979) observes that if coding is not automatic there may be competition between these alternating processes, resulting in a limited attention capacity for completing all the transformations necessary for comprehension. Lesgold and Perfetti (1978) describe an interference factor, where excessive attention to graphophonic coding can prevent access to higher levels of processing.

> In the case of reading, we suggest that word coding processes and sentence comprehension processes must be fast enough to avoid desynchronization because of memory deactivation (p. 326).

Hence speed or automaticity of the coding involved in processing print can provide sufficient attention for focusing on organizing

semantic units into an integrated whole (La Berge and Samuels, 1974).

An Interactive Model

Conceptualized within an information processing framework the top-down and bottom-up models appear to offer dichotomous interpretations of the reading process, though in fact their perspectives have offered researchers fruitful springboards for thought and further directions for research. Bottom-up models do not fully explain comprehension or the integration within higher level processing necessary for understanding continuous text. Research has concentrated on the minute analysis of letters and words (Gough, 1972; La Berge and Samuels, 1974) and fails to account for the impact of contextual and thematic processing on lower level analysis. It assumes that the human mind constructs meaning in a building block manner, starting with isolated graphic features and clustering into larger units, with higher order semantic processes waiting for the completion of lower ones (Stanovich, 1980). Top-down models have been criticized for their vagueness (Stanovich, 1980), though it is hardly surprising that research on the processing of connected discourse, with the complexity of ideational relationships within sentences and across paragraphs, lacks the specificity of research on isolated word recognition. La Berge and Samuels (1974), in explaining their model and its concentration on word recognition, observe,

> In its present simple form, the model does not spell out higher-order linguistic operations such as parsing, predictive processing, and contextual effects on comprehension. ... For present purposes, we find it convenient to separate comprehension from word meaning (p. 319),

and conclude,

> The complexity of the comprehension problem appears to be as enormous as that of thinking in general (p. 320).

Given that top-down models necessarily move from the higher to lower levels of the processing hierarchy, and initially are dealing with complex concepts, they may still be considered to offer an incomplete explanation of the reading process as they provide little explanation of the speech recoding effects, i.e., recoding the text into internal or oral speech, observed by many researchers (Perfetti and Hogaboam, 1975; Lesgold and Perfetti, 1978; Levy, 1978; Underwood and Holt, 1979). Smith (1971, 1975) excludes the concept of phonological encoding from the fluent reading process. Goodman (1970 a , 1970 b) acknowledges the role of internal or overt speech recoding for the beginning reader, but views it as a supplementary aid for the skilled reader. It is assumed that phonological recoding is only necessary when the reader needs help and is placing a heavy reliance on sampling textual features. However research by Levy (1978) indicates that speech recoding is apparent even when passages are meaningful, and "where the semantic control should be greater and less sampling required" (p. 145). Researchers have also demonstrated that reliable

differences between good and poor readers are apparent, not only in comprehension of text but also in speed of phonological coding (Perfetti and Hogaboam, 1975; Lesgold and Perfetti, 1978).

Rather than confusing the issue, the two schools of thought may have paved the way for consideration of an interactive view of the reading process. Rumelhart's (1977) interactive model isolates six levels, namely features, letters, letter clusters, lexical, syntactic and semantic, and demonstrates that processing can occur simultaneously and integratively within and between several analytic levels. The executive control is thus neither bottom-up nor top-down but each level forms simultaneous hypotheses, reacts within its own operational realm, and shares information for integration at other levels. Thus there is no clearly defined hierarchy of processing flowing in one direction or another, but comprehension is viewed as the process of synthesizing information from all levels. Levy (1978) notes that the interactive model encompasses the view that meaning can precede analysis, though acknowledging that analysis offers confirmation and exactitude. It accepts the view that for some forms and purposes of reading 'sampling' is all that is necessary, moreover forcing the reader to analyze word-by-word "hinders the fluency of his processing" (p. 145). However the model does not consider analysis as "irrelevant or inferior" (p. 145), as it may be a productive processing strategy for the beginning

reader and for the skilled reader when reading unfamiliar material and acquiring details or new information.

New research has been influenced by Rumelhart's perspective (Lesgold and Perfetti, 1978; Doehring and Aulls, 1974; Stanovich, 1980; Schwartz, 1980), and demonstrates developmental processing differences between beginning and fluent readers involved in reading comprehension tasks (Schwartz, 1980), and group processing differences between skilled and poor readers on phonological coding activities (Lesgold and Perfetti, 1978). Lesgold and Perfetti (1978) suggest an interesting metaphor to describe the synthesis of the interactive approach, and the flexibility it offers for encompassing different emphases and viewpoints:

> Both internists and surgeons accept the same basic interactive model of how the human body works and how it becomes diseased. However, the internist applies a relatively top-down approach, perceiving the body in terms of a set of systems with particular functional interactions, while the surgeon knows more about diseases that involve local function and spatial proximity. ...
>
> In the case of reading, multiple viewpoints are also needed. The bottom-up view, more surgical, traces the flow of coding information between connected components. The top-down view, more medical, concentrates on the higher-level goals of reading. Both viewpoints are needed, but both must proceed from a common, general interactive view of the reading process (p. 324-325).

The Simultaneous and Successive Model

The reader as an information processor can be viewed within the conceptual framework of Luria's (1966 a, 1966 b, 1973) theories of cognitive processing and within the model of simultaneous and successive synthesis developed by Das et al (1973 a, 1973 b, 1975, 1979 a, 1979 b), and grounded in Luria's concepts.

Luria proposes that the brain is organized in the form of three complexly interrelated blocks, "each of which makes its particular contribution to the organization of this functional system" (1966 a, p. 43). Maintaining an awake, conscious or aroused state is the function of the first block, which includes the upper brain stem, the reticular formation and the hippocampus. The second block, which includes the occipital, temporal and parietal lobes, has the functional purpose for the input, processing, coding, recoding, and storage of information. The third block of the brain, consisting of the prefrontal and anterior regions, is responsible for man's planning behaviour: namely it,

> creates intentions, forms plans and programmes of his actions, inspects their performance, and regulates his behaviour so that it conforms to these plans and programmes: finally, he verifies his conscious activity, comparing the effects of his actions with the original intentions and correcting any mistakes he has made (Luria, 1966 a, p. 80).

Luria (1966 a , 1966 b , 1973) emphasizes that the three blocks do not function in a localized manner, but integratively and interdependently.

Within the second block, simultaneous and successive synthesis occurs. Simultaneous processing involves integrating stimuli into "a single entity" (Luria, 1966 a , p. 75) or "spatial scheme" (p. 76) similar to a holistic gestalt. Luria (1966 a) describes three levels of simultaneous synthesis, perceptual, mnestic (memorial) and intellectual. Perceiving spatial wholes occurs in visual and auditory realms, for example when we glance at a picture and survey the whole, integrating the spatial relationships into "a unified visual structure" (p. 75), and also when we listen to an orchestra the rhythms, pitch and tone are integrated into a holistic music schema. Wertheimer's (1959) integration of several lights, flickering on and off at different spatial points, into a one-light-in-motion-schema is consistent with Luria's concept of perceptual-mnestic simultaneous integration of stimuli into a spatial whole. At the mnestic level Luria conceptualized the "memorizing of any logical text" (1966 a , 1966) as a good example of the synthesis of repeated words transforming into a holistic structure within the brain. At the complex intellectual level "the grasping of any system of relationships ... and arrangement of the elements into a simultaneous surveyable scheme" (1966 a , p. 76) is conceived. The synthesis of relationships is necessary for the comprehension of numerical and geometric concepts, and for understanding

the grammatical systems of language. In investigations of patients with parietal-occipital brain damage Luria noted simultaneous synthesis impairments that included difficulty with spatial orientation, spatial relationships and with logico-grammatical relationships. In the latter instance patients demonstrated confusion with elements that needed to be conceptualized in a schematic relational form, e.g., 'the brother's father' or 'the father's brother', or with spatial, prepositional relationships, e.g., 'above', 'below' and 'next to'. Similar confusion was noted with,

> ... comparative constructions, inversions, and distant clauses. Disturbance of simultaneous synthesis at this level is shown by the fact that although the patient continues to perceive individual elements of these constructions, he cannot properly understand the conceptual relationships expressed by the construction (1966 a , p. 85-86).

Successive synthesis integrates incoming stimuli into temporal or serial order. Luria describes the elements as being integrated in a chain, with each link activating the next link in a continuous, but serial, pattern. As with simultaneous processing Luria (1966 a) identifies three levels, perceptual, mnestic and intellectual. At the perceptual level of synthesis the processor can articulate sound series "in a strictly defined order" (1966 a , p. 78) or can produce a series of written letters. At the memorial level a series of elements can be conserved and retrieved

from memory, and at the intellectual level the processor is able to conceptualize a "chain of events" (Latham, 1973, p. 37), the most overt example being narrative speech. Luria's patients, with damage to the fronto-temporal regions of the brain, experienced difficulties with repeating simple rhythmic patterns, repeating numbers or words in serial order, learning lines of poetry, or carrying out tasks that required serial order directions.

Though the coding processes of simultaneous and successive synthesis have been discussed separately Luria (1966 a) emphasizes that they function in a completely interrelated manner, being "two necessary aspects of each neuro-dynamic process" (p. 79). In addition these coding processes function within the dynamically interrelated structure of the three blocks of the brain, dependent on the aroused state (block one), and the purposeful strategic action of the prefrontal lobes (block three).

Though Luria's theories emerged from studies of brain damaged patients, recent research (Das, 1973 a , 1973 b ; Das and Molby, 1975; Krywanuik, 1974; Leong, 1974; Jarman, 1975; Kaufman, 1978) has illustrated that "there are statistical and psychological realities to the simultaneous-successive dimensions" (Leong, 1971, p. 335). Das (1973 a , 1973 b) and Das, Kirby and Jarman (1975, 1979 b) have proposed an information processing model based on Luria's theory of simultaneous-successive synthesis, and planning

behaviour. They define simultaneous processing as,

> the synthesis of separate elements into groups, these groups often taking spatial overtones. The essential nature of this sort of processing is that any portion of the result is at once surveyable without its dependence on the whole (1979 b , p. 49),

and successive synthesis as the,

> processing of information in a serial order ... a system of cues consecutively activates the components (1979 b , p. 50).

They confirm that systems of relationships, for example grammatical relationships, are best understood in terms of simultaneous processing and sequential events and structures in terms of successive integration. Simultaneous and successive processing are both available to the human being, and are utilized by the individual depending on the task demands. The model envisages external input, presented in a simultaneous or successive manner, transmitted through a perceptual 'buffer' to the central processing unit of the brain. This abstracted central unit separates the incoming information into simultaneous or successive groups, which are consequently integrated and utilized by the planning and decision making block, i.e., "The third component, which could be labelled thinking, uses coded information and determines the best possible plan for action" (Das et al., 1979 b , p. 50). Within the model the 'output' unit is described as organizing "performance in accordance with the requirements of a task" (p. 50): for example, matching geometric shapes

may demand a different output organization from supplying a list of numbers in serial order.

Hence, within Luria's theory and Das et al.'s concretization of his ideas, the reader may be viewed as a simultaneous and successive synthesizer, a planner and a decision maker. The reader contributes these information processing strategies and syntheses to the task of reading. Reading is embedded in the child's knowledge and use of language (Goodman, 1968, 1970 a , 1970 b). The ability to conceptualize and utilize logico-grammatical relationships, namely to integrate syntactic structures and understand prepositional, relative and causal relationships in a reciprocal manner, is vital to the act of reconstructing meaning from print. The child never learns grammatical relationships without the context of experience, and hence semantic information, in the form of the child's concepts and knowledge of the world, is equally important. It is suggested that simultaneous synthesis is implicated in the acquisition of grammatic - semantic relationships. Speech recoding and analysis of letters, letter clusters and words appears to be a functional strategy in reading (Lesgold and Perfetti, 1978; Goodman, 1970 a , 1970 b), and successive synthesis seems to be an appropriate coding process for this type of sequential analysis. Narrative speech, an overtly successive act (Luria, 1966 a), is apparent in the comprehension task of recalling the events of stories. Though examples have been used to illustrate possible links between aspects of

reading comprehension and a particular process, e.g., narrative speech in story recall and successive synthesis, it is important to emphasize that the examples demonstrate a processing focus. Luria (1966, a.) describes the integrative nature of the human brain and observes that both simultaneous and successive coding are jointly implicated in every processing activity. The intent to use these processing strategies is obviously a component of the planning unit of the brain. It seems viable to suggest that simultaneous and successive syntheses are processes by which the reader codes, organizes, stores and utilizes information. As such they function "as dimensions of individual variation" (Das, Kirby and Jarman, 1979, b.) amongst readers, who may "vary in adeptness" (p. 51) and in their ability to utilize the processes when engaged in reading tasks. Within the present study learning disabled children with reading comprehension difficulties may possibly vary in their "adeptness" and ability to use simultaneous and successive information processes.

A Tentative Comparison

Within the human information processing perspective it is conceivable that researchers are using different models and terminology to describe somewhat similar conceptions of the brain's functional processing, organization, storage and retrieval of information. Using the metaphorical link of describing the reader as an information processor it is

interesting to examine the 'top-down' and 'bottom-up' theories, and Rumelhart's (1977) model of the reader processing print, in comparison with Luria's (1966 a , 1966 b , 1973) theories and Das et al.'s (1973 a , 1973 b , 1975, 1979 a , 1979 b) model of information processing.

A tentative comparison may be suggested between aspects of top-down processing and simultaneous synthesis, and between bottom-up processing and successive synthesis. Luria (1966 a) describes simultaneous synthesis as the integration of stimuli into "primarily spatial groups" (p. 74), and Das and Cummins (1978) note that it" is required in the formation of any holistic gestalt or in the discovery of the relationship among two or more objects" (p. 197). Palmer (1975), in explaining the interactive model of reading, describes top-down processing as "overall structure" (p. 296) with "global properties" such as "general size, location, dimensionality, orientation and so forth' (p. 296). Stevens and Rumelhart (1975) explain that top-down processing involves "working down from semantic and syntactic considerations" (p. 136). Central to the conceptualization of both top-down and simultaneous coding are the attributes of spatial grouping and spatial relationships, the holistic gestalt, and the understanding of semantic-syntactic relationships. Schema, the top-down terminology to describe a global, inclusive structure that represents relationships amongst objects and events, seems quite similar to Luria's (1966 a) description of simultaneous synthesis, which provides "a unified visual structure" (p. 75)

or "a certain scheme of spatial relationships" (p. 75). Within the complex intellectual level of simultaneous processing logico-grammatical relationships can be conceptualized (Luria, 1966 a , Das, Kirby and Jarman, 1979 b), and similarly Rumelhart's (1977) model establishes the semantic and syntactic levels as top-down, or high order coding.

Bottom-up processing and successive synthesis involves coding information in a serial, link-by-link, linear manner. Das, Cummins, Kirby and Jarman (1979 a) explain successive coding as "the formation of a code which is more temporal in nature, being accessible only in a linear way" (p. 1). Stevens and Rumelhart (1977) describe the bottom-up process in reading as decoding print "letter by letter, word by word ... working up from the physical features" (p. 137).

Hence, there appear to be conceptual similarities amongst Rumelhart, Luria and Das et al.'s descriptions of coding. However there are also conceptual differences. Simultaneous and successive processing are considered to be parallel forms of coding and thus non-hierarchical in nature (Luria, 1966 a , 1966 b , Das, Cummins, Kirby and Jarman, 1979 a). Luria's work with brain-damaged patients illustrated that one form of coding could be disrupted without interfering with the other (Luria, 1966 a , 1966 b). The parallel nature of the processes has been supported by the statistical research of Das, Cummins, Kirby and Jarman (1979 a). However it should be acknowledged that, although the coding

processes are considered to be parallel, the cognitive structures they act upon are hierarchical in nature (Luria, 1973; Das, Cummins, Kirby and Jarman, 1979 a). Luria (1973) describes these structures as primary (projection), secondary (association) and tertiary (overlapping) zones. Simultaneous and successive processing "are operations which are performed upon these cognitive structures, and which are instrumental in their transformation and integration with other structures" (Das, Cummins, Kirby and Jarman, (1979 a , p. 9). Top-down and bottom-up coding processes are conceptualized as hierarchical (Anderson, 1978), with bottom-up coding being lower order, and top-down considered as higher order cognitive processing.

Rumelhart's (1977) interactive model of reading offers a new perspective. Though the coding levels are arranged hierarchically, and function interdependently, all the levels are considered to be equally important for proficient reading. Rumelhart negates the concept that top-down processing occupies a 'superior' position, and bottom-up an 'inferior' position in the chain, but stresses their interactive contribution in processing print. Hence he views them as being parallel in importance and in functioning, to the reader. Das, Cummins, Kirby and Jarman (1979 a) emphasize a similar point in discussing the equivalent rather than hierarchical nature of simultaneous and successive processing. They suggest that we may be confusing the issue by dwelling

on the hierarchical or non-hierarchical forms of coding. A question more profitable for research may be,

> not which ability or process is "higher" or "better" or more complex, but rather which ones are employed by which individuals in which tasks (p. 10).

In considering this issue it seems viable to examine the task of reading comprehension and to analyze, in more detail, the contribution of simultaneous and successive processing to the reader involved in such a task.

Reading Comprehension and the Simultaneous-Successive Model of Information Processing

> Reading comprehension seems to involve language, motivation, perception, concept development, the whole of experience itself. It seems to be subject to the same constraints as thinking, reasoning and problem solving. ... Whatever influences general thinking or problem solving ability also influences reading comprehension. (Pearson and Johnson, 1978, p. 8-9).

Comprehension has been considered the core of the reading act (Goodman, 1968, 1970 a , 1970 b ; Smith, 1971, 1975). Cooper and Petrosky (1976), in summarizing the work of prominent reading researchers in the past decade, note the primacy given to comprehension. They observe that three themes would provide a broad framework for the research findings, namely that, (1) fluent reading is not decoding, (2) comprehension can precede the identification of individual words, and that, (3) only part of the information necessary for

understanding comes from the printed page; the reader supplying his own prior experiences, knowledge of language and his cognitive processing ability. Researchers have emphasized that the reader's goal is the reconstruction of meaning (Goodman, 1970 a , 1970 b ; Smith, 1971, 1975; Fagan, 1978). In pursuing this objective the reader makes an active contribution from his own knowledge source and utilizes his own cognitive processing strategies.

A Survey of Research Exploring the Relationship Between Simultaneous-Successive Processing and Reading Comprehension

The reader as an information processor, with the goal of "reconstructing the author's message" (Fagan, 1978, p. 229), has planning strategies and the coding processes of simultaneous and successive synthesis available for his use. The reader brings these processes and strategic behaviour to the act of reading comprehension, though it is acknowledged that readers may vary in ability and in the utilization of task-appropriate information processing. There is an increasing body of evidence to suggest that the poor reader makes inadequate use of the information processing abilities he may possess. Kirby and Das (1977), investigating the relationship between school achievement and simultaneous and successive processing, reported that grade four boys with the highest reading scores on the Gates-MacGinitie Reading Test, had the highest performance on both the simultaneous and

successive tests. The boys with the lowest scores on both the simultaneous and successive marker tests had the lowest reading comprehension scores. Two groups with moderate achievement on the reading test had high scores in only one processing area, either simultaneous or successive synthesis. Results indicated that the high simultaneous-high successive group also had a higher mean intelligence than the low simultaneous-low successive group. Traditionally, higher reading scores may have been attributed to higher scores on intelligence tests, thereby linking achievement to general ability. Equally traditionally, intelligence has been used to predict achievement though a clear theory of "the nature of intelligence" (Das, Kirby and Jarman, 1979 b , p. 69) has not yet emerged. Das, Kirby and Jarman (1979 b) negate the causal link between intelligence and achievement that has been inferred since Binet's work at the turn of the century. They note the uncertain quality of this inferred link, and describe the occurrence of the opposite effect, "i.e., early achievement causing later intelligence" (p. 70) for some children. They suggest that simultaneous - successive processing allows us to look at variations in individual cognitive performance, and thus offers a way of examining individual differences in the processing of print, within the framework of a theoretical model. Kirby and Das' (1977) results illustrate that both simultaneous and successive synthesis are required for the complex task of comprehension, and readers who utilize

the processes efficiently have higher scores in reading comprehension than those who do not. An examination of the results of the moderate achievement groups, who appeared to utilize either simultaneous or successive processing effectively, may offer suggestions for educational application (Das, Kirby and Jarman, 1979 b). An application of the Aptitude Treatment Interaction (A.T.I.) Model (Cronbach, 1975) would indicate designing programmes "to exploit the mode of processing in which the student is more adept" (Kirby and Das, 1977, p. 569), or structuring remediation programmes to improve the efficiency of simultaneous and successive processing strategies (Krywaniuk, 1974; Kaufman, 1978).

Further studies have established a link between simultaneous and successive processing and achievement in reading comprehension. Cummins and Das (1977) noted that grade three students with the lowest scores on the simultaneous and successive tests also had the lowest achievement scores on the Decoding and Comprehension sub-tests of the Edmonton Public School Board Elementary Reading Test. The high simultaneous-low successive and the high simultaneous-high successive groups had the highest scores on both sub-tests. Simultaneous processing thus appeared to be implicated in both testing activities, though successive synthesis seemed to be less related to high reading comprehension or decoding performance. When correlational analysis was performed on

the top and bottom halves of the comprehension distribution simultaneous processing appeared to relate only to the top half of the distribution, implying that "simultaneous processing may be necessary for the development of more advanced levels of comprehension skills" (Cummins and Das, 1977, p. 249).

McLeod (1978), although using a limited number of simultaneous and successive marker tests, investigated the relationship between these two forms of processing and a high level comprehension task, inferencing, using forty grade four students. He supported Cummins and Das' (1977) findings that high simultaneous performance appears to be significantly related to high achievement in reading comprehension. Using the Stanford Achievement Test, McLeod reported that the high simultaneous-high successive and high simultaneous-low successive groups were significantly better than the low simultaneous-low successive and low simultaneous-high successive groups, on the reading vocabulary and comprehension subtests.

McLeod designed an inferencing test to examine the textually supported and non-supported inferences generated by the four cognitive synthesis groups. He observed that the high simultaneous-high successive and the high simultaneous-low successive groups generated significantly more inferences that were supported by the text, than those that were not supported by textual information. The low simultaneous-low successive and low simultaneous-high successive groups demonstrated no significant difference in the production of

supported and non-supported inferences. The results indicated that the high simultaneous groups made better use of the textual information in the generation of inferences.

McLeod (1978), within his quantitative and qualitative investigation of inferencing, described the reader's production of forward-looking and backward-looking inferences:

> The "forward-looking" inferences went beyond the text to generate new information which elaborated the given textual information. The "backward-looking" inferences gave necessary information that linked a given unit of textual information with previous information, or supplied a cause for a given action in the text (p. 128).

No significant difference was noted in the overall quantity of inferences produced by each of the groups, but qualitative differences emerge. The high simultaneous groups were significantly higher than the low simultaneous groups on their forward-looking inference score, suggesting that simultaneous synthesis is an appropriate processing strategy for generating elaborated textual information. High achievement on the successive tests had a negative relationship with backward-looking inferences, the high successive groups producing low scores on this form of inference. Hence it seems that successive synthesis is an inappropriate processing strategy for "filling information gaps or bridging new information" (McLeod, 1978, p. 232).

It is suggested that the good reader, and hence the most able in reading comprehension, makes effective use of

both simultaneous and successive information processing strategies, with the emphasis being on simultaneous synthesis in high level comprehension tasks, such as inferencing. Conversely the poor reader appears to utilize cognitive processing in a less appropriate manner, and thus produces low scores on reading comprehension achievement tests, and performs less adequately on qualitative examinations of comprehension strategies. Latham's (1973) study investigated the relationship between the ability to select an information processing strategy for a verbal recall task and the comprehension of written language. He divided university undergraduate students into groups of 'good' and 'poor' readers on the basis of their performance on the Reading Comprehension Co-operative English Tests, recognizing that the designation of 'good' and 'poor' was relative, as both groups consisted of university students. He then examined the relationship between reading comprehension scores, and performance on an adapted version of Bousfield's Test of Clustering in Recall, where simultaneous synthesis was implicated as a task-appropriate process. In his findings, Latham reported that all the one hundred and fifty subjects classified as good readers selected simultaneous processing for the Test of Clustering in Recall. Within the group of poor readers Latham discovered four sub-types, (1) fifty below average readers who chose simultaneous synthesis and had high recall scores on the clustering test, (2) fifty below average readers who chose

simultaneous synthesis, but had low recall scores, (3) twenty-five below average readers who chose successive synthesis and had high recall scores, and (4) twenty-five of the poorest readers who chose simultaneous synthesis and had low recall scores. Latham concluded that no reader, with comprehension scores in the top-half of the sample, selected successive synthesis for the task. He suggested that the ability to select the appropriate information processing strategy for the comprehension of written language seemed a necessary, though possibly not a sufficient condition, for understanding print.

An Analysis of Reading Comprehension

In investigating the relationship between simultaneous and successive processing and reading comprehension it is necessary to examine the implications of the processes for the task. In this case the task is comprehension of print, with the assumption that the reader contributes his knowledge, concepts and processing abilities to share the author's communication.

Pearson and Johnson (1978) have defined three elements of reading comprehension, (1) textually explicit, (2) textually implicit , and (3) scriptually implicit. Textually explicit comprehension refers to the reader's response to questions, or elements within the paraphrase of stories read, that are "directly, explicitly, and precisely" (p. 157) taken from the text. This level of comprehension would assume that

the reader has reconstructed the answers, or recalled elements, directly from the page, i.e., made a verbatim, factual recall. Textually implicit comprehension occurs "if there is at least one step of logical or pragmatic inferring necessary" (p. 161) in the reader's response. Thus, the answer would be largely available in the text, but some minor inference would be necessary, for example, in the two sentences, "John walked up the hill. He carried a large pail", the reader is required to infer the "John" is the referent "He" in the passage. Scriptually implicit comprehension "occurs when a reader gives an answer that had to come from prior knowledge", and, "the base for the inference is in the reader's head, not on the page" (p. 162). An example of this third aspect of comprehension would be a story that began, "After Confederation the railway ...", and the child, activating his 'Canadian Confederation schema', would paraphrase, "The story began in the period of Canadian history after 1867". Pearson and Johnson (1978) emphasize the active participation of the reader in reconstructing meaning. The 'textually explicit' category implies that the reader is constrained by the textual information, whereas the 'textually implicit' response suggests that the reader has made a logical inference during the processing and retrieval of information. The 'scriptually implicit' category suggests that the reader was able to construct and re-organize ideas evoked by, but not constrained precisely by the print.

Pearson and Johnson (1978) offer an interesting qualitative approach to analyzing the processing strategies of readers involved in a comprehension activity. Examining processing strategies is a difficult task as the input and product are observable but the process is covert. However analysis of children's recalls of stories they have read can provide insight into "what a student has done with the information presented in the selection" (Pearson and Johnson, 1978, p. 129), namely it can offer useful clues concerning the information processing strategies of the reader. Berger and Perfetti (1977) summarize:

> In the paraphrase recall task, the subject ... reads a passage and is then asked to retell the story in his own words. The assumption is that during ... reading the incoming information is coded, integrated and thus organized by the subject. The free recall of that information stored by the subject would be considered to reflect the subjects organization of the input (p. 8).

Drum and Lantaff (1977) have operationalized an analysis of children's recalls of stories they have read. Fagan (1980) has adapted their technique by refining their analytic categories to provide more clarity and guidance for the researcher. The reader's recalls, or paraphrases of stories, are analyzed into T-units (thought units), which may then be "further subdivided into clauses" (Fagan, 1980, p. 1). The recalls are thus divided into syntactic units, and then assigned to a particular semantic category. Fagan outlines five possible categories:

A. Text Specific: verbatim recall, or exactly paraphrased information, from a single unit in the original text.

B. Text Entailed: information may be (1) paraphrased from more than one unit in the original text, (2) "a superordinate" (p. 3), or subsuming, statement that draws information from more than one textual unit, and (3) "an inference" (p. 3).

C. Text Experiential: information classified as 'experiential intrusions', inserted by the reader "either on the basis of his having experiences related to the theme of the passage or from his knowledge of the world and stories so that the insertion is a plausible continuance of the storyline" (p. 4).

D. Text Erroneous: faulty presentation of information, inaccurate generalizations, inferences, summaries and syntheses made by the reader.

E. Text External: very general information, including repetitions, 'storytelling conventions' and 'vague generalizations' that convey no specific or relevant details.

Similarities can be observed between Pearson and Johnson's (1978) reading comprehension taxonomy and Fagan's categories

for protocol analysis of reader's recalls of stories. Pearson and Johnson's 'text explicit' category bears a strong resemblance to Fagan's 'text specific' class. The latter differs in that pronoun substitutions and simple synonymy of a word or concept, regarded by Fagan as 'text specific', would undoubtedly be reserved for the 'text implicit' class by Pearson and Johnson. However the core of both the 'text explicit' and 'text specific' categories is comparable, as both rely on the reader's verbatim reconstruction of the text. Pearson and Johnson's 'text implicit' category resembles Fagan's 'text entailed' class, with the reader coding and organizing the textual information to generate inferences. However Fagan's 'text entailed' category allows evaluation of a broader spectrum of the reader's strategies, including his ability to synthesize and summarize information. The 'scriptually implicit' category (Pearson and Johnson) relates to both 'text entailed' and 'text experiential' categories (Fagan). The source of the 'scriptually implicit' and 'text experiential' classes lies in the knowledge and experience base of the reader, though the broad 'text entailed' category allows for case-related information, e.g., "Text: ground corn. Protocol: ground corn on a rock" (Fagan, 1980, p. 4), which would suggest an overlap into Pearson and Johnson's 'scriptually implicit' class. Fagan's scheme for protocol analysis contains 'text erroneous' and 'text external' categories. The inclusion of these classes permits the analysis of the reader's faulty or vague recall

of story elements. The researcher can thus analyze the recalls, comparing them with the original text, and assess whether the reader is able to make appropriate inferences and syntheses, i.e., category B: 'text entailed', or faulty inferences and syntheses, i.e., category D: 'text erroneous'. The utilization of this analytic procedure provides an insight into the reader's processing strategies, his coding, organization and integration of the input.

The Contribution of the Simultaneous-Successive Processing Model to Reading Comprehension

Within the conceptual framework of the Pearson and Johnson (1978) taxonomy, and the conceptually parallel protocol analysis (Fagan, 1980), it is possible to examine the contribution of simultaneous and successive processing to the task of reading comprehension.

Story recall is usually oral, with the child reading the story and then producing a narrative report, which is later transcribed by the tester. Luria (1966 a , 1966 b) has related successive processing to the narrative flow of speech, and hence it is suggested that this form of synthesis may be implicated in the production of a verbal story recall (Cummins, 1979). However, complexly intertwined in the recall task is the child's processing of semantic-linguistic information (Goodman, 1970 a , 1970 b), namely his understanding of conceptual and syntactic relationships.

Luria (1966 a , 1966 b) has emphasized the relationship between simultaneous processing and the comprehension of logico-grammatical relationships, including comparative, spatial, causal and relative relationships. Research has illustrated that grades three and four children, with high simultaneous scores, have higher achievement on reading comprehension tests, than children with low simultaneous scores (Cummins and Das, 1977; McLeod, 1978). Hence, it may be suggested that both successive and simultaneous processing, with possibly an emphasis on the latter, are involved in the reconstruction of meaning, the goal of any comprehension task. It may equally be suggested that the reader's reconstruction of meaning (process) is reflected in his verbalized story recall (product) (Berger and Perfetti, 1977; Pearson and Johnson, 1978).

Pearson and Johnson's (1978) 'text implicit' and 'scriptually implicit' classes and Fagan's (1980) 'text entailed' category describe and include the production of inferences in reading comprehension. The generation of appropriate inferences relies on the child synthesizing relationships within the story and producing either a logical inference supported by the text, or a pragmatic inference, suggested but not constrained by the textual information (Pearson and Johnson, 1978; Fagan, 1980). Based on Luria's observations, simultaneous processing has been linked to the comprehension of complex relationships, and it may thus be suggested that this form of coding contributes to the reader's

generation of inferences, when combined with his strategic, planning behaviour (McLeod, 1978; Das, Kirby and Jarman, 1979). McLeod's (1978) research reporting the inferencing efficiency of high simultaneous groups of children, adds support to the inferred contribution of simultaneous synthesis necessary for inferencing, a complex comprehension activity.

Rumelhart's (1977) model outlines the interactive contribution of semantic, syntactic, lexical, word, letter cluster and perceptual feature levels to reading comprehension. Lesgold and Perfetti (1978) have suggested that automaticity, or speed of coding, at the feature, letter cluster and word levels frees limited processing capacity for the complexity of comprehension. Successive synthesis may be suggested as an effective coding strategy for the sequential analysis, especially as such an analytic procedure appears to require phonological, or speech, recoding (Lesgold and Perfetti, 1978). Speed of coding at the word, or even sentence level, (Lesgold and Perfetti, 1978; Curtis, 1979) also seems to make a contribution to reading comprehension, not only to free processing from features to increasingly more complex cognitive tasks, but also to prevent memorial decay. Within the simultaneous-successive model a speed construct has emerged in the factor analytic research. This factor, measured by variations of the Stroop (1935) tests, is defined by "speed of verbal output' (Das, Kirby and Jarman, 1979, p. 62), which is considered to be a measure of the child's rate of processing.

The latter may be reflected in automaticity of phonological recoding, which Lesgold and Perfetti (1978) consider contributory to the efficiency of reading comprehension.

In summary, it is suggested that simultaneous and successive synthesis, speed of processing and planning behaviour, encompassed by the Das et al model (1973 a , 1973 b , 1979 a , 1979 b), make a substantial contribution to tasks of reading comprehension. Simultaneous and successive processes have been established as relatively stable indicators of individual processing differences amongst readers, with the high simultaneous-high successive groups being the most proficient and the low simultaneous-low successive groups being the least proficient in measures of reading comprehension (Kirby and Das, 1977; Cummins and Das, 1977; McLeod, 1978). High simultaneous groups appear to be the most efficient at higher level comprehension tasks (McLeod, 1978). Moderate achievement groups, in reading comprehension tests, appear to utilize only one of the processing strategies effectively, i.e., either simultaneous or successive synthesis (Kirby and Das, 1977). This suggests the possibility of structuring a remediation programme with the objective of facilitating the utilization of effective processing strategies required for reading comprehension.

Remedial Approaches

Children with learning difficulties, including those with specific reading problems, have been the recipients of a

vast array of programmes designed to alleviate their academic weaknesses.

Sabatino (1976) has identified four major classifications of remediation, (1) academic programming, (2) perceptual-motor training, (3) linguistic deficit, and (4) psychotherapy or behaviour modification schemes. Though each area differs in techniques and underlying assumptions, a common purpose is the remediation of children's learning problems. Sabatino (1976) reports that the academic approach to learning disabilities emphasizes "a concentrated effort using standard developmental teaching methodology" (p. 165), with individual or small group remediation of the basic skills, and sub-skills, believed to be the building blocks of effective achievement in school subjects. Perceptual-motor remediation focuses on the training of visual or auditory perceptual skills, either in isolation or together with motor skills, assuming that poor academic progress can be attributed to weaknesses in these areas. Rectifying or training the underlying perceptual-motor abilities would, thus, lead to improvement in higher cognitive functioning, including learning to read (Frostig, 1964; Getman, 1965; Kephart, 1960; Kirk and Kirk, 1971). Remediation based on the language deficiencies, apparent in many groups of students labeled as learning disabled, has focused on programming to ameliorate communication problems in receptive or expressive language (McGinnis, 1963; Myklebust and Johnson, 1967; Bereiter and Engelman, 1966), with the

expectancy of reducing academic difficulties for the children displaying these problems. The psychotherapeutic or behaviour modification approach emphasizes remediation of the behavioural difficulties thought to inhibit the educational achievement of many learning disabled children. Hewett's (1968) 'engineered classroom' is a classical example of this approach. The child progresses through a scheme of behavioural objectives, ranging from basic attention to a task through to an educational mastery level, with planned reinforcement being a feature of his journey through the hierarchy.

Ability Training and Task Analytic Approaches

Recently researchers and educators have subsumed the multi-categorical remediation approaches within two broad philosophical models, namely ability or process training and task analysis (Smead, 1977; Torgeson, 1979; Gillespie-Silver, 1979; Kirk and Gallagher, 1979). The ability training model assumes that "within child" (Gillespie-Silver, 1979, p. 195) processes (either neurological dysfunction or maturational lag), are causal factors in the child's poor academic achievement. Language dysfunction models (Myklebust and Johnson, 1967; Kirk and Kirk, 1971) and perceptual-motor remediation programmes (Frostig, 1964; Kephart, 1960) would be included in this approach. The task analytic model concerns itself with breaking down "complex tasks like reading into component subtasks so that an ordered series of skills can be identified"

(Torgeson, 1979, p. 518). Hence it is assumed that weak performance on a task can be improved by teaching the pre-requisite skills, rather than by remediating an inferred process within the child. Sabatino's (1976) 'academic programming' category, together with aspects of the behaviour modification approach, could be subsumed within the task analytic model.

Strong representatives of the ability training group are Frostig, Kephart and Kirk. Each of them has developed a diagnostic instrument, with the objective of identifying an underlying processing deficit, together with a remedial programme to train the weakness. Frostig et al (1964) created the Developmental Test of Visual Perception, and an accompanying training programme. The authors assume that visual perception difficulties are a causal factor in school failure, and especially in poor reading performance. The visual perception lag thus needs to be trained effectively. Kephart (1960) assumes that motor skills and perceptual deficits need to be remediated, as higher cognitive function is grounded in the sensorimotor ability of the child. Hence training in "muscular activity" (p. 79) will assist the child in developing more advanced conceptual skills, including reading. Kirk and Kirk's (1971) training programme focuses on the remediation of a linguistic deficit of a receptive, expressive or organizational nature, through auditory and visual channels. They assume that a child with an underlying linguistic processing difficulty, discovered on the Illinois

Test of Psycholinguistic Abilities (Kirk, McCarthy and Kirk, 1968), needs remedial assistance in his areas of weakness before effective school achievement is possible.

Research in recent years has neither supported Frostig, Kephart nor Kirk's assumptions, nor has it supported the efficacy of the ability training approach in general. Hammill and Larson (1974), in reviewing thirty-nine studies of I.T.P.A. training programmes, conclude that the children remediated are neither better at psycholinguistic skills nor improved in academic performance. Hammill, Parker and Newcomer (1975) examined the predictive relationship between the I.T.P.A. and school achievement. They concluded that only one subtest, Grammatic Closure, appears to relate to reading achievement, there being no significant correlation between any other subtest and academic performance. Myers and Hammill (1978), in a review of thirty-one studies of Frostig and Horne's (1964) perceptual remediation programme, report that the programme appears ineffective with regard to assisting "readiness, academic and cognitive growth" (p. 882). Myers and Hammill (1978) combined the visual perception studies with research studies on the perceptual-motor programmes of Kephart (1960), Barsch (1965), Cratty (1967), and Getman (1965), because "the systems share many similarities" (p. 383). As an analysis concluded that "80 percent of the study's results failed to validate these approaches" (Myers and Hammill, 1978, p. 383) it is also apparent that they

share the commonality of being ineffective remedial programmes for stimulating academic improvement.

Whilst the evidence has mounted to question the efficacy of many of the programmes and assumptions of the ability training approach, the task analytic school of thought has gained new momentum. Vellutino et al (1977) emphasize the utility of direct teaching, the analysis of skills and subskills necessary to complete a task, and the importance of individualized educational planning. Haring and Bateman (1977) outline the procedures for task analytic remediation, and these include setting behavioural objectives, identifying the skills, and deciding on an approach to teach the skills. The Direct Instructional System for Teaching Arithmetic and Reading (DISTAR), developed by Bereiter and Engelman (1966), and the DISTAR Language Programme (Engelman and Osborn, 1970) are examples of the task analytic approach to learning. Each subject is divided into a hierarchy of skills and subskills, to be taught in a sequential order, and in an organized manner. Difficulties may arise from solely teaching the task, as the approach concentrates on teaching specific skills, with no emphasis on possible processes that may underpin learning (Myers and Hammill, 1976). It is conceivable that a strict observance of the task analytic approach to remediation may be placing an over-reliance on rote memory, and skills learned may have limited generalizability out of the specific learning context. Guthrie and Seifert (1978) note that the underlying assumption of this approach is that

reading can be divided into a sequential list of subskills, whereas the complexity of reading makes this assumption quite questionable.

Specialized Approaches to Remedial Reading

Within a group of children identified as learning disabled the most common academic problem is the failure to acquire proficiency in reading (Lerner, 1975). Specialized remedial reading approaches have been developed that cannot simply be assigned to an ability training or task analysis approach. Several of these programmes teach reading skills via a variety of modalities. Multisensory approaches were developed by Orton (1937) and Fernald (1943), and involved auditory, visual and tactile sensory processing of letters and words. Bannatyne (1966) and Gattegno (1962) developed colour phonics systems of reading, with colour coding to assist the establishment of sound-symbol relationships. The Hegge, Kirk and Kirk Reading Drills (1936) were designed to aid the remedial reader in establishing a level of automaticity in recalling sound-symbol relationships and phonic word blending. Modified alphabets, the most well known being the Initial Teaching Alphabet (i.t.a.), have been suggested for beginning readers and those experiencing difficulty with reading (Downing, 1967). One symbol represents one phoneme, and hence inconsistencies in spelling, e.g., 'ā', 'ai' and 'ay', are reduced to one symbol. Transfer to traditional orthography is completed when the reader is able to read

fluently in i.t.a. Though these specialized reading techniques differ in technique and possibly the sensory modalities utilized, they do share a common assumption, that reading is primarily decoding graphic information. In beginning reading, or remedial reading, by reinforcing automatic responses to sound-symbol relationships the concept of reading as a meaningful activity is de-emphasized. If we define the reader as a contributor of his knowledge of language, his world experiences, and his complex information processing strategies to the task, the specialized reading systems described do not make maximum use of his contributions.

Though specialized remedial programmes have been developed it seems that the most common approach to remedial reading is the same approach as regular developmental reading in the classroom (Lerner, 1975). Karlin (1971) reflects on the similarity between remedial and developmental reading:

> Insofar as methodology is concerned there are no real basic differences between them. (p. 350).

If this indeed is the case, the child in the reading resource room may be receiving not different or specialized programming, but an in-depth repetition of the classroom reading approach; an approach in which he is failing.

<u>Cognitive Strategy Training</u>

Children with learning difficulties are believed

to have deficiencies in the cognitive processes presumed to underlie academic tasks, a factor which is implicit in many research studies and education programmes (Torgeson, 1979):

> ... when a child of normal intelligence receives essentially the same classroom stimuli and instructional programs as other children and yet makes a very different response it is logical to assume that the child is doing something differently with the presented information. ... These deviant behaviors particularly the ones taking place "inside the head" are those that have typically been referred to as the psychological processes underlying poor achievement (Torgeson, 1979, p. 515).

The difficulty with this assumption is that processes, as inferred constructs, have traditionally been difficult to identify with clarity. Torgeson (1979) also observes that the assumption that poor performance on a test is due to a processing deficiency within the child, has questionable validity. An alternate approach to identifying weak or deficit processing ability has been that of task analysis. However, though suggesting task-relevant remediation, the approach lacks any concept of individual cognitive functioning differences that may have an effect on the child's classroom learning. Torgeson (1979), in balancing the merits and weaknesses of the processing ability and task analytic approaches, suggests a viable compromise in planning remediation programmes for the learning disabled child. He suggests the preservation of the concept of examining the cognitive processing of the child, but research should avoid a fragmented

approach, i.e., isolated studies on short-term memory or perception. Instead, it should make a concerted effort to look at the task, for example reading, in terms of the processing demands it places on the child. Remediation should then focus on the specific processes required for a particular task. Within the simultaneous-successive processing model's theoretical framework both processes appear to be required for reading proficiency (Kirby and Das, 1977; Cummins and Das, 1977), with an emphasis on simultaneous processing for high level comprehension tasks (McLeod, 1978). Hence remediation focused on the improvement of children's reading comprehension would encompass both simultaneous and successive coding, with an emphasis on simultaneous processing.

In addition to suggesting a useful focus for remediation, Torgeson (1977) offers insight into the homogeneous characteristic of academic task failure displayed by learning disabled children. He suggests that these children may indeed have deficits in cognitive processing abilities, as reflected by their poor performance on short-term memory tasks (Torgeson, 1975), or the integration of information from different sensory modalities (Leong, 1974), but their weak performance may also be characterized by performance deficits, namely, "their failure to apply efficiently those abilities or capacities which are present" (Torgeson, 1977, p. 34). Torgeson (1977), in reviewing research studies exploring the use of memorial strategies (Flavell, 1971;

Hagen, 1971; Belmont and Butterfield, 1969), notes that children with learning difficulties do not spontaneously use strategies, e.g., verbal rehearsal, but their task performance is improved when they are encouraged to do so. He suggests that the learning disabled child may not have developed awareness of his own cognitive processes and processing strategies. Flavell (1971) has described these awarenesses as 'meta' variables, and Brown (1975) as "knowing how to know" (p. 110) and "knowing about knowing" (p. 111).

Flavell (1970) defines two sources of cognitive processing difficulty. He explains that some children experience task failure as they have problems "using verbal symbols as mediators in various task situations" (p. 182), or indeed any visual or enactive activity. Flavell hypothesizes that this problem can be viewed as either a mediational or production difficulty. In a mediation difficulty the child may produce a mediator, but it fails to generate relevant cognitive activity, presumably due to a capacity deficit. Such a mediational deficit is quite comparable to Torgeson's (1979) description of an ability deficit in underlying cognitive processes. A production deficit is characterized by the child's failure to produce any mediational strategy at all, which may be compared to Torgeson's (1979) performance deficit. Within the theoretical model of simultaneous- successive processing Das, Kirby and

Jarman (1979) refer to a mediational deficiency as a "deficiency in processing information, to central processes, independent of the demands of output" (p. 158) and explain that, as such, it "is largely a matter of defects in coding" (p. 158). They affirm that, though there may be lower limits of structural capacity, remediation should focus on teaching simultaneous and successive coding strategies to analyze task-specific information, with the objective of improving the efficiency of task performance. They view the teaching of isolated production skills, e.g., verbal rehearsal, as having limited utility, but rather remediation, must encompass the teaching of "how and when to use simultaneous and successive processes" (p. 158), i.e., task appropriate coding strategies, with the underlying aim of teaching the child "how to learn" (p. 158).

Das, Kirby and Jarman (1979 b) suggest that remedia-plans should follow three steps, (1) analysis of the processes underlying the task, e.g., reading (2) assessment of the child with regard to the processes, and (3) training in the task appropriate use of the processes. This three-step plan is conceptually allied with Torgeson's (1977) suggestion for combining aspects of the processing ability approach and task analysis, where remediation would focus on teaching specific processes that underlie such tasks as reading. Torgeson (1980), in a more recent article, re-affirms the advisability of further research to isolate task specific processes:

> It should be possible to analyze various school-related tasks or information-presentation methods to see how much subject-directed, information-processing activity they require for learning to take place. Research directed toward such an analysis would provide a clearer link between the failure to use efficient task strategies and failure in school than is currently available (p. 370).

He further emphasizes the utility of remediation to assist learning disabled children in selecting and utilizing task strategies by "having them perform tasks that explicitly require the kinds of active processing that leads to retention" (p. 371).

Strategies may be defined as ways,

> that will facilitate the acquisition, manipulation, integration, storage and retrieval of information across situations and settings (Alley and Deshler, 1979).

Das, Kirby and Jarman (1979 b) note that strategies include both processes and plans, i.e., decisions concerning task appropriate coding. They are a function of the child's previous task related experiences, his usual manner of response to the task (possibly culturally influenced), the processes the child has available for use, and the utilization of strategic behaviour. Two previous studies (Krywaniuk, 1974; Kaufman, 1978) have utilized strategy training remediation programmes, within the framework of the simultaneous and successive processing model.

Krywaniuk (1974) designed a remedial programme for native children in grades three and four at the Hobbema

Reserve School. Low achieving children were selected and randomly assigned to maximum and minimum treatment groups. The maximum treatment group received fourteen to fifteen hours of remediation, and the minimum intervention group received three hours of training. The groups had comparable mean I.Q.'s on verbal, non-verbal and full scale W.I.S.C. measures. They were tested on the simultaneous-successive test battery and the Schonell Graded Word Reading Test, prior to and immediately following the intervention programme. Remediation focused on successive processing as the most task-appropriate coding strategy. Whilst the training on tasks emphasized successive synthesis, simultaneous processing was not eliminated and incidental training in this process occurred (Das, Kirby and Jarman, 1979 b). The tasks did not include school curriculum related materials, nor did they replicate any of the simultaneous and successive tests. An important aspect of the remediation was the utilization of verbal training, where the child was encouraged to verbalize as he progressed through a task and was also asked to give a summary of the activity, upon completion. The verbalizations allowed the researcher partial access to the processing strategies of the child, and it was anticipated that verbally ordering task actions would assist the child in "subsequent actions" (Das, Kirby and Jarman, 1979 b , p. 160). Results from Krywaniuk's intervention programme indicated significant gains for the maximum intervention group in visual and auditory

memory tests, and on the Schonell Graded Word Reading Test.

Kaufman's (1978) intervention programme was designed for grade four children. He divided a large sample of children, at this grade level, into above average, average and below average groups, on the basis of their performance on the Metropolitan Achievement Test. The above average group was excluded from remediation procedures, but thirty-four children in the average and below average groups were randomly assigned, seventeen to an intervention group and seventeen to a non-intervention group. Each group was balanced for age and sex and had equivalent mean I.Q.'s on the Otis-Lennon. The experimental group received ten hours of individualized remediation and the control group received no training, but remained in their regular classroom programme. As with Krywaniuk's (1974) study, the tasks focused on successive processing, avoided the utilization of school-based materials and did not replicate any of the simultaneous-successive test battery. In a similar manner to the Krywaniuk (1974) study, Kaufman encouraged each child to verbalize during the task activity, and verbal task summaries were emphasized. The groups were tested, both before and after intervention, on the simultaneous-successive test battery, the Metropolitan Achievement Test and the Schonell Graded Word Reading Test. Significant gains for the intervention group, were demonstrated on all the successive tests and all but one (Raven's Coloured Progressive Matrices) of the

simultaneous tests. Significant improvement, for the experimental group, was also noted on the Schonell Graded Word Reading Test, and on the speed of coding test (Colour Naming). No significant differences between experimental and control groups were observed on the 'Word Knowledge' and 'Reading' subtests of the Metropolitan Achievement Test. Kaufman (1978) notes that 'Word Knowledge' "is essentially a measure of the child's comprehension of word meaning" (p. 217), and the 'Reading' subtest "requires the child to read and understand whole paragraphs" (p. 218). He acknowledges the reliance on reading comprehension in both subtests, and reflects that "simultaneous processing may be more important in the development of comprehension skills" (p. 218), whereas the intervention programme focused on successive processing.

Das, Kirby and Jarman (1979 b) observe:

> The two intervention studies are enough to convince one that strategies can be taught (p. 169).

Hence, within the conceptual framework of the simultaneous-successive processing model, and utilizing Torgeson's (1979) suggestion for isolating and remediating specific processing strategies underlying an academic task, it seems viable to construct an intervention programme with the purpose of remediating the processing strategies underlying reading comprehension tasks. Such a remediation programme would

focus on both simultaneous and successive processes, but would structure more tasks that relied on simultaneous processing (McLeod, 1978; Das, Kirby and Jarman, 1979 b). The objective of intervention would be to improve the performance of children, traditionally classified as learning disabled, not only in simultaneous and successive processing but also in reading comprehension.

CHAPTER THREE

EXPERIMENTAL PROCEDURES AND HYPOTHESES

The Purpose of the Study

The major purpose of the study was to measure the extent to which remedial intervention, focusing on simultaneous and successive information processing, had a facilitative effect not only in tests which load on the simultaneous and successive factors, but also on tests of silent reading comprehension, and the quality of readers' recalls of stories that have been read silently.

The study had an Experimental/Control x Pre/Post-test design and was conducted in three stages. The first stage involved screening the resource room populations of two schools, the selection of the sample of subjects, and the administration of the pre-test battery. The second stage included the planning and implementation of the remediation programme based on simultaneous and successive processing. The third and final stage involved the administration of the post-test battery, and analysis of the data, to examine the effectiveness of intervention.

Selection of Subjects

Nine to twelve year old children, recommended for, or enrolled within, reading resource room programmes at two schools within the County of Parkland, were considered for this project. Forty children, twenty at Brookwood School, Spruce Grove, and twenty at Meridian Heights School, Stony Plain, were initially screened, using the non-verbal section of the Canadian Cognitive Abilities Test (1974), and the comprehension sub-test of the Gates-MacGinitie Reading Test, Level D, Form 1 (1978). All children with non-verbal I.Q. scores below 85, or reading performance scores at or above the thirty-fifth percentile were eliminated from the study. Children with known hearing impairments, visual problems not corrected with prescriptive eye-glasses, and with English as a second language were also excluded. Hence the twenty-four children selected, twelve from Brookwood School and twelve from Meridian Heights, had non-verbal intelligence scores above I.Q. 85, and reading scores below the thirty-fifth percentile on the comprehension sub-test of the Gates-MacGinitie Reading Test, Level D, Form 1. They had no known sensory impairments and spoke English as a native language. Permission for participation in the project was obtained from each child's parents.

Students were assigned to either Experimental or Control Groups, so that each group contained twelve children. Each of the Experimental and Control Groups was composed of

six children from Brookwood School and six from Meridian Heights School (see Table 1). The Experimental Group contained four boys and two girls from each of the participating schools. The Control Group had an exactly similar composition. T-tests for independent samples were calculated to obtain measures of the Experimental and Control Group's equivalence in age, I.Q. and grade equivalent scores on the reading comprehension test. The means, standard deviations and t-ratios are presented in Table 2. No significant statistical differences were found to exist between the groups.

Screening Tests Used for the Selection of Subjects

The reading comprehension sub-test of the Gates-MacGinitie Reading Test, Canadian Edition, Level D, Form 1 (1978), was used to obtain a measure of each child's achievement in silent reading comprehension. Form 1 was administered as a screening device to isolate a group of readers whose performance was below the thirty-fifth percentile. In addition the grade scores achieved on this test were utilized in the pre-test analysis, and compared with the grade scores on Form 2 of the test, administered in the post-test battery.

Level D of the Gates-MacGinitie Reading Test is designed to assess achievement in silent reading comprehension from grades four to six, and hence was chosen for this study

TABLE 1

DISTRIBUTION OF EXPERIMENTAL AND CONTROL SUBJECTS WITHIN TWO SCHOOLS

	Schools		
	Brookwood	Meridian Heights	Total in each Group
Experimental Group	6	6	12
Males:	(4)	(4)	(8)
Females:	(2)	(2)	(4)
Control Group	6	6	12
Males:	(4)	(4)	(8)
Females:	(2)	(2)	(4)
Total in each School	12	12	24
Males:	(8)	(8)	
Females:	(4)	(4)	

TABLE 2

T-TESTS (INDEPENDENT SAMPLES): DIFFERENCES BETWEEN THE MEANS OF THE EXPERIMENTAL AND CONTROL GROUP ON AGE, I.Q., AND GRADE EQUIVALENT SCORE ON THE COMPREHENSION SECTION OF THE GATES-MACGINITIE READING TEST (LEVEL D, FORM 1)

Variables	Means		SD		DF	T	Probability	
	Exp.	Control	Exp.	Control			1-tail	2-tail
I.Q. (C.C.A.T.)	95.00	97.41	6.39	11.35	22	-0.64	0.264	0.524
Age (Months)	122.91	122.75	9.94	10.21	22	0.04	0.484	0.968
Gates-MacGinitie (Grade equiv.)	2.90	2.72	0.68	0.89	22	0.54	0.298	0.597

of nine to twelve year old students all of whom were enrolled at those grade levels. The passages in the test give "varying emphasis to material from the humanities, the social sciences, the natural sciences, and to story or narrative material" (Manual, 1978, p. 35). Comprehension of the passages is tested by response to 'literal' or 'inferential' questions, presented in a multiple-choice format. The manual describes literal comprehension as a "restatement of something in the passage" (p. 35), and inferential comprehension where the student needs to "infer something that has not been directly stated" (p. 35). At Level D the test authors qualify that 55% of the questions are at the literal level and 45% at the inferential level.

The Gates-MacGinitie, Level D, was normed on 46,000 Canadian students from urban and rural areas, and Form 1 has a reliability of .89 on the reading comprehension section (Kuder-Richardson Formula 20).

The non-verbal section of the Canadian Cognitive Abilities Test, Form 1 (1974) was used to obtain an I.Q. score on each child, and to screen any child below I.Q. 85 from the study. The Canadian Cognitive Abilities Test (C.C.A.T.) evolved from the Lorge-Thorndike Intelligence Tests, and was normed across the ten Canadian provinces and the North West Territories, using a stratified random sample of schools. The test provides percentile norms and 'standard age scores', the latter having "a mean of 100 and a standard deviation of 16", with, "the same statistical properties as the deviation

I.Q." (Technical Manual, 1978, p. 3). The multi-level edition (Levels A to F) of the test was used, this version appropriately spanning from grades three to nine. The Manual recommends Level B for grade four, Level C for grade five and Level D for grade six. The non-verbal battery of the C.C.A.T. contains three sub-tests, Figure Analogies, Figure Classification and Figure Synthesis, and requires thirty-two minutes for group administration.

The non-verbal battery of C.C.A.T. claims to measure, "abstract reasoning abilities important to learning" (Technical Manual, 1978, p. 6), and was chosen as a screening instrument for I.Q. as the score does not depend on formal reading achievement. The test authors affirm that both the verbal and quantitative tests "require considerable reading skill" (Technical Manual, 1978, p. 5). As a measure of intelligence was required that did not rely on the child's reading proficiency, utilization of the non-verbal C.C.A.T. battery seemed appropriate.

Both screening tests were administered on a group basis, on September 10th, 1980, at Brookwood School, and on September 11th, 1980, at Meridian Heights School.

<u>The Pre-test Battery</u>

The pre-test battery was administered to the twenty-four children selected for the study, between the 15th and 24th of September, 1980. The writer tested each child individually at his respective school. The testing was

completed in two sessions per child, over a two day time period. During the first testing period the Standard Reading Inventory, Serial and Free Recall Tasks and Memory for Designs were administered in approximately one hour and ten minutes. In the second session, Figure Copying, Digit Span-Forward and the two speed tests were completed in approximately twenty minutes.

The simultaneous and successive tests

The simultaneous and successive test battery has consistently been used in previous research investigating these cognitive processes (Das, 1972; Krywaniuk, 1974; Kirby, 1976; Cummins and Das, 1977; Kirby and Das, 1977; Kaufman, 1978). From this battery seven tests were selected, as research has indicated that they load consistently on simultaneous and successive processing factors or on a speed factor. Memory for Designs and Figure Copying have both loaded reliably as a simultaneous factor, and Digit Span-Forward, Serial Recall and Free Recall have loaded consistently as a successive factor. Colour Naming and Word Naming have loaded as a speed factor.

a.) Memory for Designs

Originally developed by Graham and Kendall (1960) as a test of brain damage in children and adults, an adapted version of the test has been used as a measure of simultaneous

processing. The test involves the child studying geometric shapes of increasing complexity, presented one at a time, and then drawing the designs from memory. The test is composed of fifteen cards, each measuring 13 cm. x 13 cm., and each containing one black line drawing of the geometric design on a white background. The stimulus cards, held 45 cm. from the child's eyes, and at right-angles to his line of vision, are presented for five seconds each. They are then removed and the child is asked to reproduce the design on a 28 cm. x 21.5 cm. piece of white paper. The children's completed designs are scored on the basis of criteria emphasizing the preservation of geometric relationships. The scoring system provides five possible marks for each design, allocating marks for symmetry, perspective, correct rotation, angle size, proportion, etc. Scores for each design are summed to provide a total. The maximum test score is seventy-five points.

b.) Figure Copying

Originally developed by Ilg and Ames (1964) as a pre-school readiness test, an adapted version has been used as a measure of simultaneous processing. Similar to Memory for Designs in that it requires the child to draw fifteen individually presented geometric figures of increasing complexity, it differs in that the child copies the figures and, hence, is not involved in reconstructing them from memory. Each figure is presented on the top half of a white

piece of paper, measuring 14 cm. x 21 cm., and the child is asked to copy the figure on the bottom half of the paper. The fifteen pages, containing the geometric figures, are stapled into a booklet and the child is allowed to copy the designs at his own rate. Scoring criteria emphasize the preservation of geometric relationships. Each figure is scored according to weighted standards as some spatial principles are considered to be more important than others, e.g., perspective, symmetry and spatial proportions. A maximum of two points is allocated for each figure reproduction. Individual figure scores are summed, to a maximum score of thirty points.

c.) Digit Span-Forward

This test is an adaptation of the WISC (Weschler, 1974) Digit Span-Forward sub-test, and is used, in the present study, as a measure of successive processing. The child is presented with series of digits of increasing length, and is asked to recall the series in the order of presentation. The initial series has three digits and the span increases to a maximum of nine digits. The digit series are presented as black numbers on white cards. The cards are moved along a cardboard slider, so that one number at a time is revealed through a small window in the slider. Each number is revealed for one second. When each series of numbers is completed the child verbally recalls the series. If the child is unable to

recall the series accurately he is presented with a second series of identical length. The test is discontinued when the child is unable to recall both series of identical length. The child's score is equivalent to the highest series of numbers recalled, with a maximum of nine points.

d.) Serial Recall

This test is used as a measure of successive processing, and involves presenting the child with sixteen series of words, the groups increasing in length from four to seven words. Within the sixteen word series, eight word groups are semantically similar, e.g., tall, long, big, huge, and eight groups have no semantic similarity, e.g., day, cow, wall, bar (Ashman, 1978; Snart, 1979). The tester presents the words orally at the rate of one word per second, and the child is asked to recall the series in the order of presentation. The child's response is recorded on a score sheet. Each word recalled in the correct serial position is assigned one point. To provide a test score the points are summed, with a maximum score of eighty-eight points.

e.) Free Recall

Free Recall is used as a measure of successive processing and is, in fact, the same test as Serial Recall, though different scoring criteria are utilized. The tester uses the Serial Recall record sheet and assigns points for

every word correctly recalled, irrespective of the accuracy of its serial position. For example, the word series may be, "tall, long, big, huge", and the child responds, "big, tall, huge, long". Though he would not score any points on the Serial Recall criteria, as the recall is incorrectly sequenced, he would score four points on the Free Recall task as all words are recalled. Each word recalled is assigned one point. To provide a test score the points are summed, with a maximum score of eighty-eight points.

f.) Colour Naming and Word Naming

These tests are modifications of the Stroop (1935) battery and were utilized in the study as measures of the speed of processing.

The test battery is composed of two charts each measuring 40 cm. x 70 cm., having eight rows with five positions in each row. The Colour Naming test consists of colour bars, i.e. red, green, blue and yellow, alternated so that each colour is represented ten times over the forty possible positions. On the Word Naming chart the colour bars are replaced by the words, red, green, blue and yellow, written with black letters on a white background.

In each of the tests the child is asked to verbalize the stimuli, in rows, as quickly as possible. In the Colour Naming test he verbalizes the colours by row and in the Word Naming test the words by row. The child's score is the total number of seconds taken to complete each test.

Tests of reading comprehension

a.) The Gates-MacGinitie Reading Test

The Gates-MacGinitie Comprehension sub-test (Level D, Form 1) results were used in the pre-test battery to elicit a percentile rank and grade equivalent score for each child. This group administered test required the child to read graded paragraphs and answer questions by selecting one answer out of a range of four possible answers. The test is thus not diagnostic, nor qualitative, but allows the tester to compare quantitative reading grade equivalent scores within the groups and between the groups.

b.) The Standard Reading Inventory

Qualitative individual assessment of each child's silent reading comprehension were completed, using the Standard Reading Inventory (McCracken, 1966). Form A. The Inventory has eleven stories for oral reading and eight stories for silent reading, with a range from pre-primer to grade seven. The Manual (1966) reports a reliability co-efficient of .994 for Form A (Pearson product-moment correlation). As there are more passages for oral reading at the lower grade levels, and as the Form A and Form B (post-test) oral reading passages share similar subject matter, these passages were used as silent reading passages for the purpose of this study.

The test requires the child to read a graded passage silently, and then recall the selection in his own words. His recall of the story is taped, and the tester later transcribes a verbatim report of the recall. The child's recall is evaluated with regard to ten specific questions, and his unaided score reflects the number of correct responses in his recall. For example, if seven units of information in the recall correctly answered 7/10 of the passage questions, his unaided score would be recorded as 7/10, or 70%. If units of information in the unaided recall do not answer all of the ten questions the child is aided in his recall, and asked to respond to directed questions. Hence an aided recall score would be the sum total of the questions answered in the unaided recall, plus the aided response to questions. For example, if the child's unaided recall is 7/10, or 70%, and he correctly answers the three remaining questions (3/10, or 30%), the total aided response to the story would be scored as 70% (unaided) + 30% = 100% (aided). This allows the tester to investigate the child's organization and retrieval of story information, and in addition his comprehension of the story when supplied with the organization provided by the questions.

The test also permits the tester to establish a classroom instructional reading level for each child. When the child's aided response drops below 70% the child is considered to be at the frustration level. The last level where the child's aided response is at 70%, or above, is established

as his instructional reading level. For example, if the child scored 70% (aided) on the grade 2.5 passage, and 40% (aided) on the grade 3.0 passage, his instructional level would be established as grade 2.5.

Within the present study, the transcriptions of children's recalls, at their instructional reading levels, were analyzed according to Fagan's (1980) protocol analysis. Each recall was analyzed into clausal units, and the units assigned to semantic categories: namely to one of five possible categories, 'text specific' (A), 'text entailed' (B), 'text experiential' (C), 'text erroneous' (D), and 'text external' (E). This qualitative analysis allows the tester partial access to the processing strategies of the child involved in a reading comprehension task at his instructional level.

The Intervention Phase

The remediation programme for the Experimental Group, focusing on simultaneous and successive processing, commenced on October 1st, 1980, and was concluded on November 19th, 1980 (see Chapter Four). During this period the Control Group received reading resource room assistance. In addition, both groups participated in the regular classroom reading programmes.

The Post-test Battery

The post-test battery was administered to the

twenty-four children in the study, between November 21st and November 28th, 1980. All the tests given in the pre-test battery were re-administered in order to determine the effectiveness of intervention. Alternate, but equivalent, forms of the Gates-MacGinitie Reading Test, Level D (Form 2), and the Standard Reading Inventory (Form B) were given to each child. The Gates-MacGinitie Reading Test was administered as a group test, but as with the pre-tests, all other tests were administered individually. The tests were presented in the same order as the pre-test battery.

Scoring of the Pre-test and Post-test Batteries

All the tests within the study were scored by the writer. The initial screening tests, the comprehension section of the Gates-MacGinitie Reading Test, Level D, Form 1, and the non-verbal sub-test of the Canadian Cognitive Abilities Test, were scored immediately upon completion in order to select the sample of subjects. On the pre- and post-test administration of the Standard Reading Inventory, unaided and aided recalls were scored during the testing sessions, and the instructional reading level of each student was established at that time. Similarly the Digit Span-Forward, Serial and Free Recalls and the speed tests were scored during the testing sessions.

The Memory for Designs, Figure Copying, and the semantic protocol analysis of the readers' recalls were

scored after the post-testing period to allow for maximum consistency in scoring, and to permit an inter-rater reliability to be established on each test. The Arrington Formula, i.e.,

$$\frac{(2 \times \text{Agreements})}{(2 \times \text{Agreements}) + \text{Disagreements}}$$

(Feifel and Lorge, 1950, p. 5)

was used to establish the degree of inter-rater agreement on a random sample of eight children's test responses for each of the three tests. Judge One for the Memory for Designs and Figure Copying tests was a faculty member of the University of Alberta's Educational Psychology Department. Judge One for the protocol analysis of story recalls was a faculty member of the University of Alberta's Elementary Education Department. Judge Two, for each of the tests, was the writer.

TABLE 3

Test or Analysis	Proportion of Agreement Amongst the Judges
Memory for Designs	.97
Figure Copying	.95
Semantic Protocol Analysis	
a) Division into clausal units	.97
b) Assignment to semantic categories (Fagan, 1980)	.94

The inter-rater agreements would suggest that the criteria for scoring Memory for Designs, Figure Copying and the protocol analysis could be applied reliably.

Hypotheses and Rationale

Hypothesis 1: Improvement in performance on the simultaneous-successive test battery, following remediation, will be greater for the Experimental Group than for the Control Group.

A post-test improvement for both Experimental and Control Groups may be expected due to maturation, previous exposure to the format of the pre-test battery and, possibly, due to incidental classroom exposure, during the intervention phase, to tasks that may focus on simultaneous processing, e.g., building and comparing geometric solids in mathematics, or successive processing, e.g., clapping rhythms in music. A greater improvement for the Experimental Group is hypothesized, due to the intensive training on the task-appropriate utilization of simultaneous and successive processing during remediation. Krywaniuk's (1974) intervention programme for low achievers in grade three, focusing on successive processing, facilitated significant post-remedial improvement in the successive tests (Serial Recall and Free Recall), the simultaneous tests (Figure Copying and Raven's Progressive Coloured Matrices), and the speed test (Colour Naming), for the Experimental Group. Kaufman's (1978) remediation study

for average and below average grade four students also focused on successive processing, and illustrated significant post-intervention improvement in all the successive and simultaneous tests, other than the Raven's Progressive Coloured Matrices, for the Experimental Group. Though both groups demonstrated pre-post test improvement on the simultaneous-successive battery (other than the Raven's Progressive Coloured Matrices), there was a significant Experimental-Control x Pre-Post interaction which Kaufman attributed to the effectiveness of the cognitive strategy training programme. On the basis of these findings it seems appropriate to suggest that the Experimental Group will demonstrate greater pre-post improvements than the Control Group on the simultaneous-successive tests.

Hypothesis 2: Improvement in performance on silent reading comprehension grade scores, following remediation, will be greater for the Experimental Group than the Control Group.

During the seven-week intervention period both groups will be exposed to classroom reading instruction. In addition the Control Group will be receiving resource room assistance in reading. It is anticipated that both Experimental and Control Groups will demonstrate improvement, over time, in reading comprehension. The Experimental Group will receive strategy training focused on simultaneous and successive processing. Reading appears to rely on the

successful integration of both simultaneous and successive processes (Kirby and Das, 1977), with the suggestion that simultaneous processing may be utilized for higher level comprehension tasks (Cummins and Das, 1977; McLeod, 1978). The remediation tasks focus on successive and simultaneous processing, with an emphasis on the latter process, due to its inferred link to the understanding of semantic-grammatical relationships (Luria, 1966, a.) and inferencing (McLeod, 1978). The comprehension sub-test of the Gates-MacGinitie Reading Test, which will be used to test this hypothesis, requires the child to respond to inferencing questions (45% of the total questions). In addition, comprehension of the graded reading material involves the child in understanding semantic-grammatical relationships across paragraphs. A confirmation of this hypothesis may be taken as a demonstration of the successful application of both successive and simultaneous synthesis, with the possible emphasis on the latter, to the task of reading comprehension at the grades four, five and six levels.

Hypothesis 3: Improvement in silent reading instructional levels, following remediation, will be greater for the Experimental Group than for the Control Group.

The Standard Reading Inventory will be used to test this hypothesis. The Gates-MacGinitie allows a quantitative Experimental-Control x Pre-Post comparison of reading grade

equivalent scores. The Standard Reading Inventory permits a comparison of the classroom instructional reading levels of the children, based on an alternate method of assessing comprehension. In this task the child is required to read a graded story and reconstruct the story verbally. In addition he may be required to answer directed questions. As all the children will be receiving classroom reading instruction, in addition to either resource room assistance or cognitive strategy training, it is anticipated that both Experimental and Control Groups will achieve higher pre-post test instructional reading levels on the Standard Reading Inventory. However it is hypothesized that the Experimental Group will demonstrate significantly higher pre-post test instructional levels than the Control Group, due to the remediation procedures. Intervention emphasizes the utilization of strategies to employ task-appropriate simultaneous-successive processes inferred to underlie tasks of reading comprehension (Kirby and Das, 1977; Cummins and Das, 1977; McLeod, 1978). Completion of the remedial tasks requires the child to organize task materials, predict suitable strategies, verbalize the stages of the task, and summarize the activity. Participation in the tasks requires the child to classify, sequence, organize, memorize, predict, synthesize and generalize, all of which, it is suggested, are highly related to the active storage, processing and retrieval of story information. Hence, confirmation of this hypothesis, by an Experimental-Control x

Pre-Post test interaction, would suggest the effectiveness of cognitive strategy training for the improvement of reading comprehension as measured by story recalls and directed questions.

Hypothesis 4a: Increase in the production of more 'text specific' (A), 'text entailed' (B), and 'text experiential' (C) semantic units within story recalls, following remediation, will be greater for the Experimental Group than for the Control Group.

Hypothesis 4b: Decrease in the production of 'text erroneous' (D) and 'text external' (E) semantic units within story recalls, following remediation, will be greater for the Experimental Group than for the Control Group.

The semantic protocol analysis permits examination of the quality of the information presented in the reader's recalls of stories. Production of 'text specific' information implies that the reader is constrained by the text and reconstructs verbatim units from the passage. Production of 'text entailed' information suggests that the reader is able to reorganize textual information, summarize and synthesize ideas from the story and make appropriate inferences. The reader's production of 'text experiential' information suggests that the reader, though not specifically constrained by the

text, is utilizing experiential information to continue the storyline. The inclusion of 'text erroneous' and 'text external' units of information suggests that the reader is experiencing difficulty with summarizing and synthesizing relationships across paragraphs, and in making appropriate inferences. Hence, the reader producing largely 'text specific', 'text entailed', and 'text experiential' semantic units, would be more effective in textual reconstruction than the reader producing largely 'text erroneous' and 'text external' units. Rumelhart (1977) has suggested that reading comprehension evolves from a simultaneous interaction amongst 'top-down' (semantic-syntactic) and 'bottom-up' (features, letters, words) levels. Das, Kirby and Jarman (1979), in a parallel manner, suggest that an integration of simultaneous and successive processing, with an emphasis on the former for high level comprehension tasks, is necessary for successful reading comprehension. Goodman (1970 a, 1970 b) notes that the effective reader reconstructs meaning by predicting likely events from his world knowledge and concepts, sampling graphic, phonic, syntactic and semantic cues to confirm his predictions. Simultaneous processing has been linked to understanding semantic-syntactic relationships (Luria, 1966 a), conceptualizing a gestalt or holistic schema (Luria, 1966 a), and making inferences (McLeod, 1978). Successive processing has been linked to the narrative flow of verbal language, the sequencing of features, objects and events (Luria, 1966 a), and isolated word recognition (Krywaniuk, 1974; Kaufman, 1978). It is suggested that

effective comprehension requires the holistic gestalt necessary for understanding relationships within a paragraph, and equally requires the comprehension of syntactic order, sequential events, and the ability to sample grapho-phonic information. Hence, the reader integrating simultaneous and successive processes may be effective in conceptualizing the gestalt of a paragraph and in sampling the grapho-phonic and semantic-syntactic cues to conform his conceptions and predictions. Confirmation of Hypotheses 4a and 4b suggests the viability of the utilization of cognitive strategy training, within the framework of the simultaneous-successive model, for the remediation of reading comprehension difficulties.

Analysis of the Data

A one-way analysis of variance was used to assess the similarity of pre-test means of the Experimental and Control Groups on all the test scores in the pre-test battery.

Major analyses consisted of two-way analyses of variance, Factor A being Groups (Experimental and Control), and Factor B being Test Scores over Time (Pre/Post). Thus, repeated measures were involved for Factor B. The independent variables in the study were the Experimental and Control Groups, and the Pre- and Post testing periods. The dependent variables were the seven tests in the simultaneous-successive battery and the tests of reading comprehension.

CHAPTER FOUR

THE INTERVENTION PROGRAMME

Grouping and Scheduling for Intervention

A group of nine to eleven year old children who were recommended for reading resource room assistance were given initial screening at Brookwood School, Spruce Grove, and Meridian Heights School, Stony Plain. Twenty-four children from the group were selected for the study. Pre-testing on the Stroop tests, the simultaneous and successive battery, and the silent reading comprehension test was conducted between September 15th and 24th, and twelve children were assigned to the Experimental Group and twelve to a matched Control Group. Each group consisted of six children from Brookwood and six from Meridian Heights.

The Control Group children received regular reading instruction in the classroom, and in addition fifteen hours of small group reading assistance from the resource room teachers at each school. The children received thirty minutes of remedial reading instruction, on a daily basis, commencing on October 1st. The Experimental Group received regular classroom reading instruction, and in addition fifteen hours of strategy training from the author. Tutoring commenced

on October 1st, and took place daily. The children were seen in groups of two, to approximate the reading resource room grouping, and each session was thirty minutes in length. The remediation sessions were conducted in small, but well-lit, workrooms at each school.

With the co-operation of the homeroom teachers regular daily times for remediation, in reading and strategy training, were assigned to the children in both the Experimental and Control Groups. The two resource room teachers, at Brookwood and Meridian Heights, and the author kept a daily log of attendance and post-testing was initiated when each child had completed the fifteen hours of remedial reading or strategy training. Post-testing was completed on November 28th.

The Programme

Children experiencing difficulties with academic tasks may be experiencing deficiencies in the coding processes that underlie the tasks (Das, Kirby and Jarman, 1979). As an information processor the reader uses simultaneous and successive processes, and hence poor readers may inadequately utilize the processes underlying a reading comprehension task. As the Krywaniuk (1974) and Kaufman (1978) studies have illustrated, training in processing strategies can facilitate an improvement in coding efficiency and improved performance in academic tasks. Remediation thus focuses on strategic behaviour, or teaching the child how to use the processes,

and aiding the development of, "effective techniques of structuring task information in order that performance in completion of the task can be improved" (Das, Kirby and Jarman, 1979, p. 172). It is recognized that the decision making or planning unit of the brain bears responsibility for when to utilize the appropriate processes for a particular task (Das, Kirby and Jarman, 1979).

Previous studies (Krywaniuk, 1974 and Kaufman, 1978) have examined the effects of strategy training on coding and school achievement, and have emphasized successive processing primarily during the intervention phase. This study was designed to examine the effectiveness of training both simultaneous and successive processing on coding and children's silent reading comprehension. When designing the intervention programme the, "integrative activity of the cerebral cortex" (Luria, 1966 b , p. 74) was acknowledged, and hence the impossibility of isolating the two basic forms of integrating incoming information, namely simultaneous and successive processes. The two processes, though having unique characteristics, share an interactive interdependence in coding information. The remediation tasks were designed to place primary focus on either simultaneous or successive processing, though it is evident that a neat separation is not possible.

The child's verbalization of task procedures was actively encouraged in the intervention programme, so that strategies used could be monitored. Verbalization was also

advocated to aid the child in summarizing and organizing his ideas, as Das, Kirby and Jarman (1979) have reported that two difficulties experienced by the low-achieving child are that:

> (1) he not only does not organize his material, but he may not realize the necessity to do so; (2) he does not use whatever verbal-successive skills he has in solving a problem (p. 159).

Jensen (1966, a.) has emphasized the active role of verbal mediation in problem solving, learning and retention of information. He defines verbal mediation as, "thinking out loud" (1966 b, p. 101), or, "'talking' to oneself in relevant ways" (1966 b, p. 101), as an aid to concept development and solving problems. Flavell (1970) views mediation and "thinking" (p. 195) as synonymous, and verbal mediation, e.g., spontaneous verbal rehearsal, as a "problem-solving strategy" (p. 195), which informs one that "the problem has indeed engaged his (the child's) attention and energies" (p. 195). Jensen (1966 b) views verbal mediation not only as a facilitator for problem solving in a specific context but also as an aid to transfer or generalization of strategies. It is suggested that the child who is not using mediational techniques makes a direct motor response to the incoming stimuli. The mediating learner reacts to sensory stimuli through a network of symbolic or verbal associations and responds to these. Hence the child using verbal mediation may not be bound to react to stimuli in a specific context, but may be able to transfer the experiences and reactions,

through association, to other situations. Thus verbal mediation was encouraged and emphasized in the strategy training tasks to enable the author to monitor the child's approach to an activity, as a problem-solving strategy for the child, and also as a potential facilitator for generalization of strategic behaviours.

The Tasks

At the conclusion of each task a description of the primary focus of the intervention procedure has been summarized, and illustrative selections of the children's verablizations have been included. Appendix B provides examples of the task materials.

Task 1: TRACKING (An adaptation of a pre-school diagnostic test (Venger and Kholmovskaya, 1978).)

A large card (55 cm. x 70 cm.) was pinned on the wall just above desk height from the floor. On the card was a line drawing of a map of a 'village' of thirty-two numbered houses, twenty-four lettered fir trees, toadstool landmarks, five main roads and several side streets. Twenty-two tracking cards (18 cm. x 12 cm.) were placed on a desk in front of the wall map. Eleven of the tracking cards illustrated a line drawing from a starting point to a specific, numbered house, and eleven illustrated a journey from the same starting position to a lettered fir tree. The tracking card map outlined the roads and street intersections, and the child's

task was to survey the card and the village map and locate the number of the house or the letter of the tree. Task la asked the child to complete the house-tracking cards and Task lb to complete the tree-tracking cards. Three timed trials were allowed for each task.

Step 1: The card of the village map was hung on the wall at the child's eye-level. A desk was placed in front of the map, and the eleven Task la cards were positioned on the desk. The teacher explained to the child that:

a) each tracking card was a journey from a 'tuft of grass', at the start, to a house.
b) he was to imagine that he was the village mailman and had to deliver a letter to the house shown on the tracking card.
c) the map had to be surveyed and the tracking card used to find the correct house. Careful attention had to be paid to the directions of the streets and the landmarks on the tracking card and the map.
d) the house number had to be written on the answer sheet, e.g., Card 1 = House 3.
e) the task would be timed, i.e., completion of all eleven cards, and he should find the houses as rapidly as possible.

The child was asked to explain the task, to check that he had understood the directions. If the child was unable to verbalize the directions a spare, trial journey card was

produced and the teacher re-explained the task instructions, and asked the child to repeat them in his own words.

Step 2: The child completed the eleven tracking cards in Task 1a, by locating each house and marking the house number on a prepared piece of paper. The task was timed.

Step 3: The child's location of the houses was checked, and he was asked to verbalize his procedure on several cards, e.g. "I knew the road had to go straight up to the fir tree, and then I went to the right. I passed the second intersection, travelled to the first house and delivered the letter to house thirty-two". If the child made errors the teacher asked him to re-do the journey, verbalizing the route, until he reached the correct house.

Step 4: The child repeated the timed task twice more. Between each timed trial the child was asked to summarize the task, and discussion focused on the strategies and clues used to complete the journeys more rapidly, e.g., shape of the roads, distances and landmarks.

Step 5: During the next teaching session the child reviewed the task and was asked to complete the eleven cards on Task 1b, where the child was asked to complete a tracking journey to a fir tree, in order to meet a friend. The child was given three timed trials on Task 1b, with the object of completing the task more speedily on each trial. Strategies of visual searching, and using visual clues and landmarks, were reviewed between each timed trial.

Step 6: Summary of Tasks 1a and 1b: Discussion and directed questions focused on verbalization of the stages in the task, and reviewed the importance of organized visual scanning, and using all available clues, such as landmarks, distance between intersections, and comparative shapes of the roads on the map and the tracking card.

Task Focus: Primarily the task was designed to focus on simultaneous processing. Simultaneous synthesis or the "integration of the individual stimuli arriving in the brain into, simultaneous, and primarily spatial groups" (Luria, 1966, p. 14), would be the most effective processing strategy to survey both the map of the village and the line drawing on the tracking card. Successful completion of the journey involved preserving the spatial relationships amongst roads, streets, houses, trees and toadstools, and comparing the spatial organization with the tracking map. Verbalization of the journey involved both simultaneous and successive coding. Simultaneous processing would be used for surveying the tracking card and map as the journey was described, and successive processing for sequencing the narrative chain of events from start to completion, e.g., "First I travelled straight up, and then I turned left at the second toadstool".

The children's verbalizations aided in the investigation of the strategies used for the task. Two children had very slow times on the first timed trial of Task 1a. Though neither child produced spontaneous verbalization, when asked

to explain how they completed the task they made the following responses,

Steven: "First I pointed a bit of the way on my card, then I checked on the map, then I pointed a bit further ... to the next turn-off."

Ronnie: "I look at the intersections one at a time. I count, this one, then this one, then this,"

demonstrating that they were using primarily a successive strategy to complete the task. At the completion of trial three, when each of their timed trials was less than half of the speed of the first attempt, they explained,

Steven: "I looked for the shape. By the end I could tell at a glance. I learned to ignore half the map. I just looked at one side or another. If I wanted to be fast I just looked at the road directions in a glance."

Ronnie: "Now I look at the distances and judge it ... and if the roads twist, and whether it's left or right of the main road,"

appearing to demonstrate a change to the more successful, task appropriate, simultaneous processing strategy.

<u>Task 2</u>: <u>MAGIC WINDOW</u> (Adapted from the Magic Window Test, Kaufman Assessment Battery for Children, Kaufman, A.S., and Kaufman, N.L., 1980).

The child's task was to identify a picture of a common object, when the object was partially revealed through

a 5.5 cm. x .5 cm. slit. The pictures were presented on revolving discs and part of the object was constantly surveyable through the window slit. The disc was numbered from one to five, at the back, to allow the teacher to gauge the timing of a five second revolution of the disc. As the disc was revolved the picture was gradually revealed in the narrow window. Six discs, with eight objects pictured on each wheel, were presented to each child. Discs one to five were not ranked in order of difficulty, though disc six was more difficult as the pictures were black and white line drawings, with no colour to aid identification.

Step 1: Task directions were given to the child. The teacher explained that:

a) pictures would appear in the window slit as the disc was revolved.

b) only part of the picture would be revealed at any one time.

c) as the disc revolved the object would be shown, and the aim of the task was to predict what the picture might be when only half of it had been revealed, and to identify it entirely when all the object had been exposed.

The child was asked to summarize the directions to ensure that he had understood the task.

Step 2: The teacher sat opposite the child and placed disc one upright on the table, so that the child could

see the window slit clearly, and the teacher would revolve the disc smoothly. The disc was revolved half-way on the first picture, to the 2.5 marker (2.5 seconds), and the child was asked to predict what the object was going to be. To focus on a synthesis of elements, or relationships, the child was asked direct questions, e.g., "Why do you think it is a fish?", "Could it be anything else?", or, "Why don't you think its a lizard?" The child was also encouraged to verbalize his thoughts spontaneously, e.g., "I think it's a mouse. It has a long tail and the body looks small and furry."

<u>Step 3</u>: The wheel was revolved to complete the picture (an additional 2.5 seconds), and the child was asked to change or confirm his earlier prediction, and give reasons for his answer.

<u>Step 4</u>: If the child was unable to identify the completed object Steps 2 and 3 were repeated, without the five second time constraint. As the wheel was revolved slowly the child was asked to verbalize about all that he could see. If the child was still unable to identify the picture the teacher revolved the disc once more and 'modeled' a verbalization that emphasized observation of parts and a synthesis of parts into wholes.

<u>Step 5</u>: The procedures were repeated with the other five discs.

<u>Step 6</u>: Summary of the task: The child was asked to summarize the task and directed discussion focused on

obtaining clues from the pictures, fusing parts into wholes, and the value of prediction and confirming or changing one's prediction on the basis of new or further information.

Task Focus: This task was designed to have a simultaneous processing emphasis. The task demanded that the child synthesized parts or elements into meaningful wholes. The child effected 'closure' by surveying the object and conceptualizing the spatial relationships amongst the parts. A secondary focus was in successive processing, through the child's narrative verbalization of what he had seen. Though the child's sequential narration emphasized successive processing, prediction of the nature of the object when partially revealed focused on simultaneous synthesis, as the child needed to integrate the spatial information already received to effect a meaningful closure. Checking the prediction equally stressed simultaneous processing as the child had to preserve the relationships synthesized from the first part of the picture to compare with the new information, as the latter half of the picture was revealed.

The following examples of the children's verbalizations illustrate the synthesis of parts into wholes, the preservation of spatial relationships as predictions were checked, and the confirming reasons for the final decisions on object identity:

Shannon: "I think it's a snake. It has a long neck. It could be a dinosaur. No ... I don't think so,

there's no brain bump on the head. Yes I was right. It's a snake ... the body's all curvy and the head fits." (Snake)

Ronnie: "It's a building, no ... yes like a cabin. No it's a fence ... a gate and a fence. There's hinges on the gate and it's open." (Gate)

Nicole: "It's a square box, no a block ... on no it's a table I think. Sure, it has legs, but it looked like a block you know." (Table)

Russell: "It's a duck I think ... I know it's a hawk 'cos it don't have a duck's beak either." (Eagle)

Task 3: SHAPE DESIGNS

'Table-Top Logical Elements' (Philograph Publications), a box of forty-eight solid plastic shapes, was used for this task. The box of shapes contained circles, rectangles, squares and triangles in three colours (red, blue and yellow), two sizes and two thicknesses. The teacher had one box and the child was given another, exactly similar box. Two sets of designs were made, Set A with five levels of difficulty and three designs at each level, and Set B with four levels of difficulty and three designs at each level. The designs ranged from a simple combination of three shapes, differing only in colour, to a complex combination of six shapes, differing along dimensions of colour, shape, size and thickness. At each level of difficulty three tasks of comparable complexity

were planned. The child's task was to study a design made by the teacher, for ten seconds, and then to reproduce the design with his own coloured shapes. The child started on Set A, level one, and worked through to the complex level of Set B, level four.

Step 1: Introduction: Before the task began the child was encouraged to explore the coloured shapes, and to verbalize the similarities and differences he observed. In this manner the teacher checked that the child had noted differences in colour, shape, thickness and size, and could also label the shapes as circles, squares, rectangles and triangles.

Step 2: Task directions: The child was told that,

a) certain coloured shapes would be shown, arranged in a design.

b) the design would be exposed for ten seconds and then covered.

c) the task would be to reproduce the design accurately.

The child was asked to repeat the task directions to ensure that he had understood the explanation.

Step 3: The teacher constructed the first design in Set A, behind a screen made of white card. The design was exposed to the child for ten seconds and then covered by the white card. The child made his copy of the design using his plastic shapes. He was encouraged to talk about the design, and spontaneous verbalizations and strategies were noted by

the teacher, e.g., "The big blue rectangle has a red circle below and a yellow circle under that", or, "It looks like a red and yellow snowman with a big blue hat". The verbalization of the shape design emphasized discussion of the relationships between elements that composed the whole design, either through noting the proximity of shapes and their spatial relationship within the pattern, or through an associative process, e.g., "It looks like a truck".

Step 4: If the child was unable to reproduce the design accurately the model design was revealed, and the child was asked to verbalize the relationships within the pattern, either in terms of shapes, colours, sizes and spaces, or in terms of associations, e.g., "What does it look like?". The design would be covered once more and the child asked to construct it again.

Step 5: The child progressed through the Set A designs on one day, and at the end of the session was asked to summarize the task. Questions and discussion focused on surveying the model design, and on using clues to aid the memorization of parts and their relationship within the whole design. Three strategies emerged that proved to be effective, two associative ones, i.e., "What does it look like?", and, "Makes up a story about it", and one where the proximity and spatial relationships were overtly noted, i.e., "next to", "below", "a space", and, "above". These three strategies were noted on a chart.

Step 6: The next day the task was reviewed by the child, and the three strategies noted on the chart the previous day were discussed.

Step 7: The child worked through the Set B designs, repeating the procedures in steps three to five.

Step 8: Task summary: With the aid of the chart the child summarized the task, and the effective strategies were reviewed. As a concluding activity the child made up two designs, one that he thought could best be reproduced by associative processes, and one design where noting proximity and spatial relationships could be the primary focus for attention.

Task Focus: The task was designed to focus on simultaneous processing. The pattern was surveyable as a whole and to reproduce it the child needed to observe and integrate the spatial relationships amongst the shapes. Part discrimination of colour, shape, thinkness and size had to receive attention, and the parts had to be seen within their spatial relationship to the whole design. Children who preferred the associative techniques as primary strategies were associating meaning to the 'global', whole design, and then attending to discriminating parts, before fusing them into a simultaneous scheme. The children who rarely used the associative strategies, nevertheless appeared to code in a simultaneous manner, noting the spatial proximity and relationship of the parts and synthesizing them into a whole shape

design. Verbalization, or recall of strategies used to complete the task, placed a secondary emphasis on the successive nature of narrative speech.

The following verbalizations illustrate the children's descriptions of how they conceived the task. The first set of examples are from children who were using simultaneous processing and associative strategies.

Ronnie: "It looks like a fishing dock, and I pretended I'd got three fish for the three blue ends."

Susan: "It's like a winking parrot. The beak is red and there's one red round eye, and a triangle for the other ... that's the one that's winking."

Brent: "I thought of Mickey Mouse rolled out flat and squashed by a roller. See he's got red ears (small circles), and a blue nose (circle), because he's out of oxygen."

Nicole: "It's a clown face, one side yellow, the other blue, and red eyes and a red lipsticky mouth."

Russell: "It's a truck with a round window in the cab and a spare wheel on top."

A small number of children appeared to process several designs in a successive manner.

Steven: "Well first I said red square ... like I said first red, then blue, then yellow to remember ... then the first colours, red and blue, for the circles."

Blain: "I split it in my head into three bits. First I said there's a circle, then I said the rectangle and last I thought there's a triangle.

The verbalizations provide an insight into how the task was processed, and these recalls do appear to indicate a successive approach, which was effective for the child. However it is equally possible that the child processed in a simultaneous manner, and the narrative sequential nature of the recall superimposed a later successive focus during the task explanation.

Task 4: MATRIX LETTERS (Adapted from Matrix Letters, Kaufman, 1978)

The child was taught to memorize a sequence of randomly chosen letters within a five-cell matrix. Each cell of the matrix measured 4 cm. x 4 cm., and contained one letter. No letter appeared more than once in each matrix. The matrix was designed as a cross, with one central cell, and one cell on each of the four sides. Each matrix was drawn on a 21 cm. x 28 cm. piece of white paper. The child was shown the complete matrix containing one letter in each of the five cells. Then the child was shown the matrix letters in five stages, with one letter revealed at each stage, i.e., page one revealed the matrix outline with the top cell letter shown and the other cells empty; page two showed all the cells empty except for the letter in the left-hand side cell, etc. Hence the child

was shown the letters in sequence in a series of five presentations of the matrix. After progressing through the sequence the child was asked to recall the letters, in order, on a blank matrix which was covered with a clear plastic sheet. The child wrote the letters on the plastic using a washable ink marker, and after each completed matrix the sheet was wiped with a damp cloth.

Step 1: Task directions: The child was told that,

a) he would be shown a group of five letters and allowed time to study them.

b) he should indicate, "First this one, then this one ...," etc., as the letters were revealed, naming each letter and pointing to the relevant square.

c) he would be asked to write the letters on the plastic sheet, in the same position that he saw them.

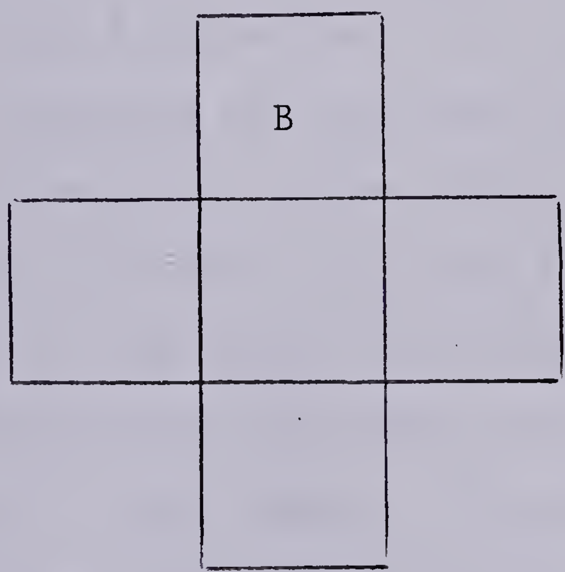
The child was asked to explain the directions to ensure that he had understood the stages of the task.

Step 2: The child was shown the first matrix, each cell containing one letter, for five seconds. The child pointed to and named the letters in each cell.

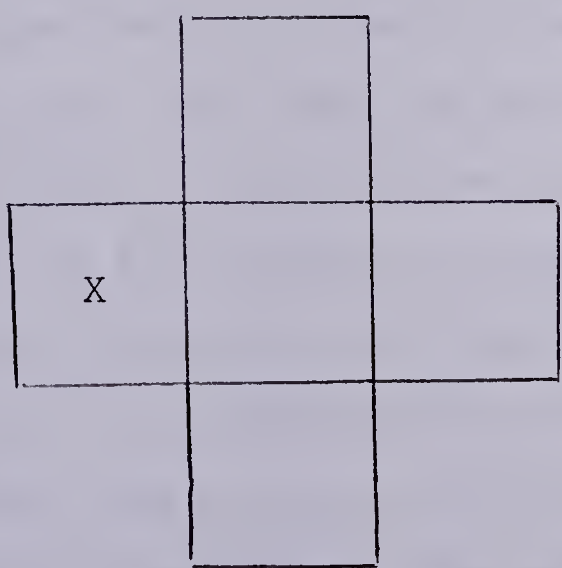
Step 3: The child was shown the five matrices, and guided through the sequence of letters, e.g., "First the B", as he pointed to the top cell on the first matrix.

Step 4: The child recalled the letters and wrote them on the blank matrix.

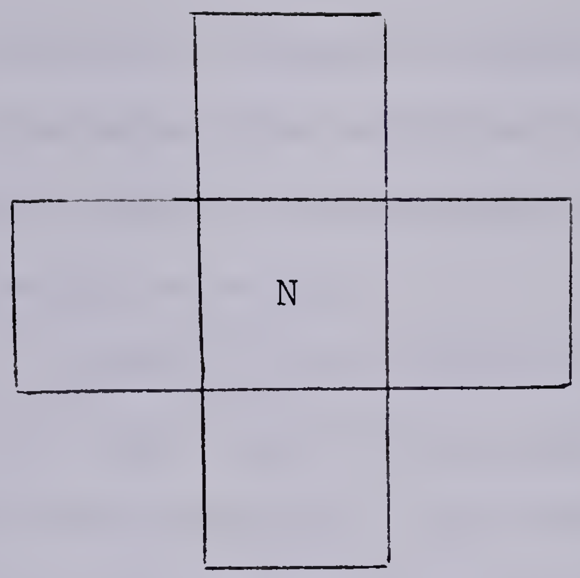
Step 5: If the child was unable to recall the five letters in the correct order steps two to four were repeated. However on this second trial the child was encouraged to point to the blank cells on the matrix and rehearse the letters verbally, or silently in his mind, e.g.,



Child: "First the B." (Pointed to the B.)



Child: "First the B (pointing to the blank first cell), then the X" (pointing to the letter).



Child: "First the B (pointing to the blank first cell), then the X (pointing to the blank second cell), and thirdly the N" (pointing to the letter).

He was then asked to write the letters on the blank matrix.

Step 6: The other five matrices were presented and the child completed them following the same procedures.

Step 7: Task summary: The child was asked to summarize the task and discussion focused on visual search patterns, verbalization to aid in serial recall, and the usefulness of rehearsal as a memory strategy.

Task Focus: The task was designed to focus on successive processing. The child was guided sequentially through a series of five numbers, and asked to verbalize the order indicating, "first this, and then this ...", etc. The task presentation thus emphasized the integration of the letters, "arriving consecutively in the brain" (Luria, 1966, p. 74), into successive series. The successive nature of narrative speech, verbalizing serial order directions, reinforced the sequential processing format of the task.

The children's comments offered the teacher a way of noting the strategies that may have been used to complete the task. Several children immediately appeared to use a successive processing strategy.

Blain: "Well I think out the letters, B, then B, X, then B, X, N, and I say it in my head."

Daniel: "I use five fingers. I put one down for each letter ... like when I see B, I think B, and put my thumb down."

However a small group of children appeared to be relying on the first matrix where the letters were printed in each cell, and possibly were relying on a simultaneous processing strategy.

Russell: "It confuses me when I go through all the letters one after another. I like the first sheet. I get N in the middle and it's like a star with letters next to it .. then I remember."

Myrick: "Can you show me the first picture again after we've gone through all the bits. I can get the boxes next to each other when I see them all. The bits make me forget."

When the letters were presented in a sequential chain these children did not seem able to integrate or synthesize them, so that one letter evoked the response of the next letter in the series. The children were given three trials, studying the 'global' matrix of five letters, but were not able to recall the set of letters using their strategy. Hence,

step five was utilized with these children, pointing to the blank cells and rehearsing the letters at the same time. This appeared to be an effective successive strategy.

Task 5: MATRIX NUMBERS (Adapted from Matrix Numbers, Kaufman, 1980)

This task involved the child memorizing a sequence of numbers within a five cell matrix. The matrix design and presentation followed the same pattern and procedures as Matrix Letters, the only difference being that randomly chosen numbers replaced the letters in each cell.

Step 1: Task directions: The child was told that,

a) he would be shown a group of five numbers and allowed time to study them.

b) he should indicate, "First ..., second ...," as the numbers were shown, naming each number and pointing to the correct square.

c) just as in the letter task, he would be asked to write the numbers on a plastic sheet, in the same position that he saw them.

The child was asked to explain the instructions to ensure that he had understood the task.

Step 2: The child was shown the first matrix, each cell containing one number, for five seconds. The child pointed to each number and named it, verbalizing, "First ..., second ...," etc.

Step 3: The child was shown the remaining matrices, in order, and encouraged to verbalize the sequence of numbers.

Step 4: The child was given the blank matrix and asked to recall the numbers and write them in order.

Step 5: If the child was unable to recall the numbers accurately he was reminded of the rehearsal strategy used in step five of Matrix Letters. On a second trial he was encouraged to use this strategy, verbalizing the numbers as they appeared on each matrix, but also pointing at the blank cells and rehearsing those numbers silently to himself. He was then asked to recall the numbers and write them in order on the blank matrix.

Step 6: The other five number matrices were presented and the child completed them following the same procedures.

Step 7: Task summary: At the completion of the six number matrices the child was asked to summarize the task. As in Matrix Letters, discussion focused on visual search patterns, verbalization to aid in the recall of the serial ordering of numbers, and rehearsal as a memory strategy.

Task Focus: For the reasons presented in Matrix Letters this task focused on successive processing. The children appeared to be using successive synthesis for the task, as the teacher observed that all the students wrote down the numbers on the blank matrix in the order presented in the original matrix, i.e., they wrote the number first in

the cell presented first, and the second number in the cell presented second, etc. None of the children verbalized a concern that the sequential breakdown of the matrices interfered with memory processes, and none requested to be shown only the first matrix with the numbers in each cell. One of the children who had made this request in Matrix Letters was asked to explain the strategy he used to remember the numbers,

Myrick: Well I see a number and think it, then next time I see an empty box and I think the old number, and then say the new number I see. I pretend the old number is there and say it over to myself ... then I say the new number,

illustrating Myrick's use of the step five rehearsal strategy, and successive processing of the task material.

Task 6: PICTURE STORY SEQUENCING (Modified from Kaufman's (1978), Picture Story Arrangmenet task, and using the Photo Series A and B kit from the Kaufman Assessment Battery for Children (Kaufman, A.S., and Kaufman, N.L., 1980)).

The Picture Story Sequencing task consisted of four sub-tasks, ranging from the simple level of arranging four pictures in a sequence, to the more complex level of arranging ten pictures to tell a correctly ordered story. Task 6a required the child to sequence seven stories, each containing

four pictures. In Task 6b the child was asked to sequence six stories, each containing five pictures, and in Task 6c he had to reconstruct nine stories, with six pictures required for each story. The final task, 6d, was more complex in that the child had to build five stories, one with seven pictures, one with eight, two with nine, and one with ten pictures. The pictures in each task were coloured photographs mounted on 10 cm. x 15 cm. white cards. Each of the sets of pictures, within each sub-task, depicted a complete story or event, and each picture was lettered on the back of the card to indicate the correct position in the sequence. The subtasks were presented to each child in an order of increasing difficulty, i.e., beginning with Task 6a, with four cards in a picture story, and finishing with the ten card story sequence in Task 6d. The child's task was to order each of the stories into a correct and meaningful story order.

<u>Step 1</u>: The cards for the first picture story in Task 6a were placed in a random arrangement on the table, facing the child. The task was introduced by explaining to the child that,

a) the cards contained photographs that told a story when placed in the correct order.

b) the cards were presently not in the correct story order.

c) the cards needed to be rearranged so that they told a sensible story.

d) he should indicate, "First this picture, second ...," etc., as he reconstructed the story.

e) after the story was completed he would be asked to provide a title that best described the events of the story, and also he would be asked to decide what may happen next in the story, or what happened before the first pictured event.

The child was asked to explain the task directions to check that he had understood them.

<u>Step 2</u>: The child was asked to study the pictures in the first story series, and to arrange them in order, verbalizing, "First this picture, second ...," etc. Any spontaneous strategies were noted, e.g., verbalizations, hesitations or self-corrections.

<u>Step 3</u>: The child was asked to re-tell the story, by pointing at each picture and verbalizing the chain of events, e.g., "First ... happens, and secondly ...," etc.

<u>Step 4</u>: The child was asked to supply a title that best described the events in the story sequence. He was also asked to give reasons to support the suitability of his title.

<u>Step 5</u>: The child was asked to predict a suitable beginning or ending to the story in one of two ways:

a) by pretending he was the photographer and drawing a facsimile of a final or initial photograph in the series, with a felt marking pen on a plastic sheet.

b) by describing the next or preceding event verbally. He was always asked to give reasons to support his predictions.

Step 6: If the child's arrangement of pictures was inaccurate and the child was unable to correct it, the teacher would offer organizational assistance by using one of the following procedures:

a) by providing the initial picture in the story and asking the child to complete the sequence.

b) by limiting the pictures to the presentation of the first half and then the second half of the story sequence, so that the child ordered the sequence of events within a restricted range of pictures.

Later in the session the child was asked to reconstruct the story sequence once more, with no organizational aid from the teacher.

Step 7: Task summary: The child was asked to verbalize the stages of the task. Discussion focused on the verbal recall of the story events, and the useful strategy of ordering the actions or chain of events in a story. Clues used in ordering the story events were discussed, e.g., the diminishing amount of food on a plate, or the body position of a person feeding the swans. Finding titles and predicting events were reviewed and the child was asked to summarize clues and key story ideas that helped him with those tasks.

Task Focus: The task was designed to focus primarily on successive processing, the child ordering a series of events

into a serial chain, and reinforcing the sequencing through verbalization of, "First this happened, and then this ...," etc. However simultaneous processing was interwoven through the task procedures. To order the events in the story the child had to survey the whole and the parts that integratively composed the whole. Events, and spatial positions had to be compared across the photographs, and connecting ideational relationships formed. Giving the story a title focused on simultaneous processing as the child needed to synthesize the relationships that characterized the story as a 'global' whole. To predict initial and final segments of the story a synthesis of key relationships within the picture series, and an overall conceptualization of a story schema were necessary.

Due to the nature of the task design, and the successive format of the verbalized recall, the children explained their ordering of the pictures in a serial manner:

Russell: "First I noticed the candle was big and someone was lighting it, then second it was littler, third it was even littler and fourth it was nearly out."

Daniel: "Well first off she's coming up to the ducks (swans), second she bends and this duck comes to eat. Third, all the ducks want food but she's only bread for one, so in the last picture they all go ... they know only one duck'll be fed, but I bet she gets more food from the car and then the others'll come back."

The first recall illustrated a bare structure of serial ordering, though giving evidence that the child had surveyed the whole, and noted the time and cause and effect relationships between lighting the candle and its burning down. The second recall also provided evidence of successive processing, though his inferences may indicate that the child has integrated the relationships of ideas within the story into a story schema of simultaneous nature. It was interesting to note that the children who made inferences had little difficulty suggesting suitable titles,

Daniel: "A Candlelit Dinner", "Feeding the Ducks", "The Moving Car ", and "Building a Toy Log Cabin".

Nicole: "First Swimming Lesson", "A Balloon Blowing-up Competition", "The Popsicle Stick House", and "Icing a Chocolate Cake",

whereas several children, who experienced little difficulty with the verbalization of story events, did have problems when they appeared to use primarily successive processes to provide a story title,

Russell: "Candles that are big, and get lit, and they get littler and littler."

Katherine: "Water gets deeper to the waist, and deeper then to the neck ... in the lake."

Steven: "Well this cake gets made, and they put icing on and it's finished.

The latter children appeared to create a miniature 'chain of events', rather than a more global and inclusive title statement.

Task 7: COMMUNITY PUZZLE

For this task the child was asked to construct a large 91 cm. x 60 cm. colourful puzzle mounted on heavy card and depicting a city scene with a wide range of activities, streets, buildings and park areas (Community Picture Puzzle II, Developmental Learning Materials). There were eighteen straight-edged pieces in the puzzle, providing a minimum of the shape clues usual in a regular jigsaw puzzle. A small, 27.5 cm. x 21 cm., black and white picture of the scene was provided. To construct the community puzzle the child needed to survey the black and white picture, and the puzzle pieces, to note how the separate activities, roads, buildings and parks related to each other and to the whole scene. The child had to preserve these primarily spatial relationships to reconstruct the scene accurately. Directed questioning by the teacher provided the opportunity for visual tracking of various journeys that were possible within the context of the map, e.g., the child was asked to survey the map and find the fastest route by which the mailman could reach the school. After silently working out the route the child was asked to recount the journey verbally.

Step 1: The child was provided with the puzzle pieces laid on the floor in random order, and the black and white picture of the scene. He was told that,

a) the black and white picture was a small picture of the large scene on the jigsaw, when it was put together accurately.

b) the task was to build the jigsaw as quickly as possible, using the small picture as a guide, and any clues that were on the jigsaw pieces.

c) the task would be timed, and over two days he would be allowed three trials.

The child was asked to explain the instructions to check that he had understood the task.

Step 2: The child constructed the jigsaw and his time was recorded.

Step 3: The child was asked to explain the strategies he had used to complete the task, and the clues he had received from the black and white picture and the jigsaw pieces. The child was asked to suggest techniques he could use to complete the jigsaw more rapidly. Two children were unable to explain their strategies, as they found the task extremely difficult on the first trial. Both children requested assistance after spending thirteen and fifteen minutes, respectively, attempting to construct the jigsaw. The teacher noted that several of the puzzle pieces had been inaccurately placed, and that both children rarely looked at the black and white picture during

construction, relying on a random strategy of picking up the nearest puzzle pieces and matching them on the basis of a small detail, e.g., grass, a duckpond or a tree. With these children discussion emphasized use of the picture guide, visual scanning techniques, and the consideration of the spatial relationships within the whole, e.g., "What is next to the park?"

Step 4: The child completed two more timed trials in constructing the puzzle, and the times were recorded.

Step 5: After the third timed trial the child was asked to visualize the journeys of people pictured in the jigsaw puzzle, e.g., "the boy with the kite to go swimming at the Y.M.C.A.", or, "the taxi driver to the hospital". The child was asked to locate the person and the destination, and visualize the journey in his mind. The child was then asked to describe the journey verbally.

Step 6: Task summary: The child was asked to review the strategies he had used to complete the task. Discussion focused on the use of visual scanning patterns, spatial relationships within the guide and puzzle, e.g., the relationship of a person to a building or a park to a store, or detail clues on the puzzle pieces, and the shape of the part in relation to the whole jigsaw. The unity of the parts within the whole was emphasized in reviewing the 'journeys' of people travelling from one section of the puzzle to another.

<u>Task Focus</u>: Primarily the task focused on simultaneous processing. Luria (1966 b), noted:

> When we glance at a complicated picture, we do not at once perceive all its parts, but, examining them gradually, we distinguish their essential elements (those giving maximal information) and we synthesize them into a single entity, a unified visual structure (pp. 74-75).

During the task the child was required to scan the detailed guide picture, discriminate details and features, and integrate the essential spatial relationships amongst the roads, buildings, people and pictured events, to create a unified, total jigsaw. The visualized 'journeys', linking specified people in the jigsaw to locations, also placed emphasis on the coding of spatial relationships and the conceptualization of a unified schema. Verbalization of the 'journeys' emphasized successive processing, as the child explained the chain of events or sequence of landmarks necessary for the person to reach his goal location.

The children's verbalizations provided an interesting insight into their task strategies. The two children who initially appeared confused by the task, and could not complete it, were asked how they thought they might be able to finish the puzzle:

Ronnie: "I'm not sure what I do ... like there's so many pieces."

Katherine:"I can't ... you see there's pieces missing. I looked all over for the other bit of this tree but it's not here, there's got to be a piece missing."

After thorough strategy discussions (step 3), these children were encouraged to re-build the puzzle, talking through the relationships and clues as they constructed it. Ronnie then explained:

"I can look at the little picture (the black and white picture guide) more and see what's happening and what's next to what. I get the road part okay (the one-way street on the left side of the map), but over there (the park area, factory and school on the right side), ... well that'll take time."

demonstrating that he had integrated information into a meaningful spatial scheme from one half of the picture, but had as yet been unable to discriminate parts on the right side of the puzzle, to synthesize or fuse into a unified whole.

However most of the children reported strategies that indicated a focus on simultaneous processing:

Blain: "I look for three things that tie in the picture, the one-way street, the second road and the river that goes through the top of the picture."

Steven: "I get my boundaries ... the four corner scenes and then the centre, the house with the apple tree, and I look for the buildings, cars and things between the corners and the centre."

Nicole: "I look for what's next to what, like the river is over the road and between the hospital and the fire department."

Shannon: "I go for the big buildings first, and see how they fit in together, then I look at the people and what they're doing."

Task 8: MAZES

Six mazes, selected from, "Hidden Pictures and Mazes" (Ideal School Supply Company, 1975), were mounted on 23 cm. x 23 cm. blue card and covered with an acetate sheet. The mazes were presented individually to the child, who was asked to complete each one using a washable ink marker on the clear plastic sheet. The child was asked to complete each maze as rapidly as possible, and he was allowed three trials, each timed with a stopwatch. The felt marker trials were wiped off the plastic sheet between each timed trial.

Step 1: The child was presented with Maze A and told that,

a) the dog at the bottom of the picture wanted to reach his bone at the top of the picture.

b) to reach the bone a path had to be found through the maze.

c) to go through the maze a route had to be traced with the felt marker, from a selected entrance to the exit by the bone. The dog could only travel through the

the gaps in the maze and could not break through any 'walls'.

d) he had to find the dog's route through the maze, as rapidly as possible.

e) tracing the route would be timed.

The child was asked to review the task verbally, to ensure that he had understood the directions.

Step 2: The child completed the maze by selecting a suitable entrance, tracing the route with a felt marker, and completing it by arriving at the bone. The child's time was recorded.

Step 3: The child was encouraged to verbalize the strategies he had used to complete the task. Questions and discussion were directed towards the strategy of scanning the maze in an organized way, visually tracking ahead down the pathways, and keeping the exit with the bone within the visual field whilst surveying the maze alleys.

Step 4: The child completed the first timed trial on each of the five mazes, and each time was recorded.

Step 5: On the completion of the timed trials the child was asked to review the strategies he was using, e.g., organized visual search patterns, and keeping the spatial relationships between the start and finish of the maze in mind. He was asked to suggest ways in which he might decrease his speed on the second set of timed trials through the mazes. Many of the children suggested, "Looking ahead more", and,

"Not stopping at every corner", re-emphasizing the need for visual scanning to aid in planning the route.

Step 6: The child completed two more timed trials, on consecutive days, with the objective of decreasing the time taken to finish each maze. The acetate sheets were wiped clean between each trial.

Step 7: Task summary: The child was asked to review the task verbally, and discuss strategies that helped him complete the mazes more rapidly. Visual search patterns, including scanning ahead and preserving the position of the goal location, were the focus of discussion and questioning.

Task Focus: The task was designed to focus on simultaneous synthesis. To decrease time over the three trials the child needed to preserve the spatial relationship between the start and finish, and scan the spatial arrangement of the alleys and walls to trace the route. Hence each maze had to be analyzed and the spatial organization recognized, the child discriminating the essential parts, and fusing them to form a track, or unitary route, between the start and finish. Conceivably the child could attempt to focus on successive processing by saying to himself, "First I'll go down this path, and try here". However this method would be time consuming, and to decrease the time spent doing the maze a transition to the more task-appropriate simultaneous processing would seem necessary. Verbalization of strategies relied on sequential recall of techniques and clues, and hence on successive processing.

The children's verbalizations offered few clues on the strategies used in this task. Most of the children commented that they, "Looked ahead", and tried to avoid, "Stopping at corners", and several noted that they preferred to start from the exit and trace back to the start, as the maze may have had several entrances and only one exit. Their responses did provide some evidence of planning and simultaneous processing. Steven's comment,

> "I'm not sure how I got there ... it all happens so fast I don't know what I'm thinking",

may support the idea that he was processing in a simultaneous manner, as rapid, efficient performance on the task would imply efficient coding, and efficient coding for this task would focus on simultaneous synthesis.

Additional clues on processing strategies were provided by observing the children's felt marker outlines of the routes through the mazes. On the first trial several children produced routes with broken lines, short jagged lines, and lines that hit the maze obstructions before the child made a new decision on the route. These patterns suggested that the child was not using an organized scanning technique, and was only processing information in small spatial segments, rather than observing broader spatial relationships. In addition, two children followed blind alleys in a maze and when they realized there was no clear route they stopped the task. When asked what would be a reasonable strategy to

pursue, one child said that he would start again, and the other child said, "Go to the next maze ... this one has no answer". However, after the second and third trials the children's route outlines were smooth and continuous, their speed had decreased, and all thought the mazes possible to complete. The children appeared to be processing in a manner that was consistent with the task demands, i.e., simultaneous synthesis.

Task 9: TRANSPORTATION MATRICES

The child was taught to memorize a series of three, six and nine pictures in the correct order, and the commercial game, "Traffic Lotto" (Schmid, Munich), was adapted and used for this task. The six lotto cards each measured 17.5 cm. x 17.5 cm. and each contained a nine cell matrix. Within each cell was a coloured picture of some form of transportation, e.g., a tank, a jet or a speedboat. Fifty-four individual cards, measuring 5.5 cm. x 5.5 cm., contained transportation pictures that matched the pictures on the six matrices. No picture had been produced more than once, and hence each of the fifty-four cards contained a different picture. For the purpose of this task the matrices were cut into differing sizes, to offer levels of complexity that ranged from a three cell picture strip, to six and nine cell matrices. The child's task was to recall the transportation pictures in the correct order, i.e., the order presented on the three cell strip or on each matrix.

To facilitate the memorization of the pictures the child was presented with a strip or matrix lotto card, and was asked to select the individual picture cards that matched the pictures in the cells of his card. In a similar manner to Matrix Letters and Matrix Numbers the child was then shown the matrix or strip broken down into component parts, with the positions of the pictures indicated, e.g., for a three cell design the child was shown the picture strip, matched the individual cards to the cells, and then placed the individual cards down on the correct positions on three successive card-board strips that had each been divided into three cells (5.5 cm. x 5.5 cm.). The cards were then removed, mixed with a random assortment of twelve cards from the pack, and the child was asked to re-select the appropriate cards and place them in the correct order on a blank, three cell, cardboard strip. The child worked through ten sets of picture matrices, four containing three cells, four with six cells and two with nine cells.

Step 1: Task directions: The child was told that,

a) he would be shown a picture strip and some individual picture cards showing different kinds of transportation.

b) he would be asked to match the individual pictures with the relevant transportation pictures in each cell of the picture strip.

c) as he matched them he would be asked to verbalize, e.g., "First the bus, secondly the jet ..." etc.

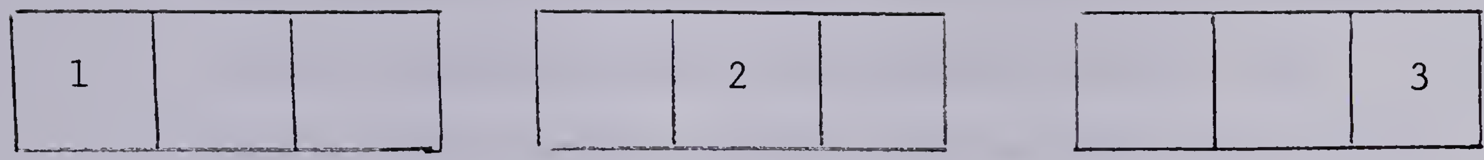
d) he would be given time to practise the order of the pictures on successive cardboard strips that had numbers marked in each cell, e.g., picture one would be placed on the first cardboard strip, in cell one, and he should say, "First the ...", etc.

e) the cards would be removed and needed to be re-selected and sequenced on a cardboard strip that had been divided into cells.

The child was asked to explain the directions to ensure that he had understood the task. If the child was unable to explain the task a sample picture strip was produced and the teacher modeled a task demonstration of the procedures. The child was then asked to explain the task once more.

Step 2: The child was presented with picture strip A, which contained three pictures. The three individual pictures that matched the pictures on the strip were mixed with a random assortment of ten transportation picture cards from the pack. The child was asked to select the individual cards that matched his strip, and to say, "First the ..., secondly the ..., and lastly the ...", as he matched each card in order.

Step 3: The cardboard strips, each divided into three cells and numbered in sequence, were placed on the table, i.e.,



The child was encouraged to match his first picture with cell one on the first card, saying, "First the ...". This procedure was followed for cell two on the second strip and cell three on the final strip.

Step 4: The cards were then picked up in the practised order and placed within the random assortment of ten cards. The child's picture strip was turned over, and he re-selected the appropriate cards and re-constructed the picture series in the correct order on a blank cardboard strip, divided into three cells.

Step 5: The child looked at his original picture strip and checked his ordering of the cards.

Step 6: The task was reviewed and the child asked to summarize the methods he used to complete it accurately. Discussion focused on visual search patterns, verbalization and rehearsal as an aid to serial recall.

Step 7: The child progressed through the three picture tasks and then the six and nine picture matrices. Every child was able to recall the three cell picture series in the correct order. However if a child was unable to recall the more complex series the following procedures were used:

a) the child was asked to re-verbalize his rehearsal

procedures on the component strips and was reminded of the technique used in the Matrix Letters and Matrix Number tasks, namely that as each new picture was verbalized he should recall in his mind the previous pictures, e.g., before verbalizing, "Thirdly this is ...", he should recall silently what pictures one and two had been.

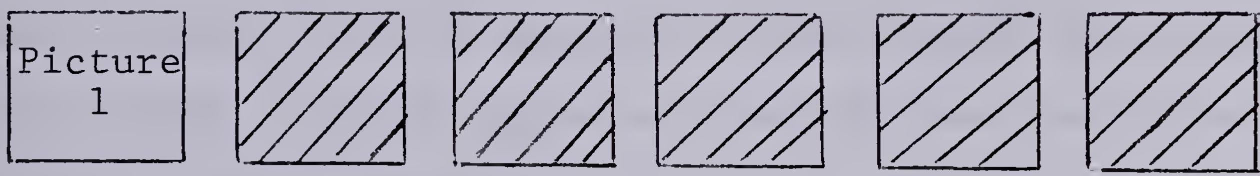
b) the cards were not placed with the ten other picture cards and re-selected, but the child's pictures were considered a closed set, shuffled separately, and then the child concentrated on recalling the correct serial order without the additional task of scanning for the relevant pictures.

If either of these procedures was used the child was asked to do the task once more, repeating steps two to five.

Step 8: Task summary: After completion of the nine cell matrices the task was reviewed. Questions and discussion focused on consistent visual scanning patterns, verbalization of task strategies and rehearsal as a memory device. Discussion extended to how the strategies in this task, Matrix Letters and Matrix Numbers, could help with other tasks, e.g., remembering science equipment to collect from a storage area, a shopping list or a car license plate.

Step 9: The task was extended to include an alternate method of presenting the pictures. Six set of pictures were selected randomly, two sets containing six

pictures, two containing seven, and two having eight pictures. The child was presented with a blank nine-cell matrix and the teacher showed the child a picture series exposing each picture for two seconds, e.g.,



The picture cards were then mixed with ten other randomly chosen cards. The child was asked to re-select the appropriate cards and place them on the blank matrix in serial order.

Step 10: The child was asked to review the techniques he had used to complete step nine, and discussion focused on the usage of appropriate memory strategies, e.g., rehearsal, imagining the pictures on the blank matrix, and picturing the numbers one to six in the correct positions on the matrix.

Task Focus: The task was designed to focus primarily on successive processing. The child was asked to approach the picture memorization in a sequential manner, verbalizing, "First the ..., second the ..., and lastly the ...", etc., as he matched the individual pictures to the picture strip. This approach was reinforced by the rehearsal strategies on the component strips, when the child repeated the sequential order of the pictures. Thus the task appeared to emphasize a successive processing approach in the same manner as Matrix Letters and Matrix Numbers. However, the sub-task of scanning to select pictures, and the fact that

the whole picture strip or matrix was totally surveyable during the task, suggests that simultaneous synthesis was woven strongly through the activity. The materials used were pictures, rather than letters or numbers, which may have altered the task demands to simultaneous processing. Luria (1966, b.) has suggested that pictures may demand global, spatial synthesis.

The children's verbalizations suggested that several of them viewed the task as one that required successive coding,

Daniel: "I say in my head, first Bobcat, the Swiss jet, then garbage truck."

Nicole: "I keep repeating ... red car, red car and black train, red car and black train and yellow truck."

However several children's comments indicated that though successive synthesis may have been involved in memorizing the serial order of the pictures, the picture strips and matrices were primarily coded in a simultaneous manner, integrating spatial information into a global whole.

Blain: "It's a car park. There's a country bus drawn in ... a car next to it. They look up as the jet flies over low."

Steven: "I think it's a highway with all those vehicles next to each other."

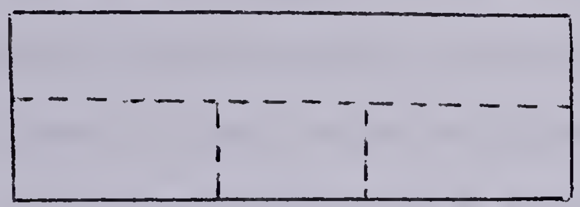
Ronnie: "I'm a millionnaire. I buy anything and today I'm going in the showroom and buy all these."

In step nine the task was extended to include an alternate, serial order, presentation of the pictures. This was done to eliminate the surveyable picture strip, and to re-focus the task on successive synthesis. The pictures were then presented in a narrative, sequential manner, with only one picture observable in the chain at any one time. Observation then focused on viewing whether the children then conceptualized the task in a different manner, and whether simultaneous coding or largely successive processing was used for the task. Insight could only be provided through observation of the children's task behaviours and verbalizations. In the step nine section of the task successive processing seemed the most task-appropriate coding. Almost all of the children were observed to sub-vocalize serial order rehearsals, several pointed in sequence to the relevant cells in the blank matrix, and none reported any global observations of a holistic nature in task recalls. Steven's response reflected the successive nature of his task approach,

Steven: "It's like this, red cable car (pointing to cell one), then the yellow digger (pointing to cell two), and last ... like on this row ... like ... an army tank."

Task 10: LETTER CONSTRUCTION

This task was adapted from a letter construction task in a "Sesame Street" magazine (October, 1980). It involved the child surveying attached rectangles and deducing the capital letter they might form, when cut into separate strips and re-arranged, e.g.,



= E

The child was presented with five letter construction tasks, the attached rectangular designs being cut from orange construction paper and each measuring approximately 12 cm. x 7 cm.

Step 1: Task directions: The task was explained to the child and he was told that,

a) he would be shown a coloured piece of paper divided into a series of rectangles by black dotted lines.

b) he was to imagine cutting the paper along the dotted lines, and reducing the large design into small rectangles.

c) he had to predict what capital letter the rectangles could form if they were re-arranged with no over-lapping pices, and no shapes omitted.

d) he would be given the opportunity to check his prediction by cutting out the rectangles and

arranging them into the shape of an appropriate capital letter.

The child was asked to explain the task to ensure that he had understood the directions.

Step 2: The child was given the first task, a set of four adjoining rectangles (the letter E). He was asked to imagine cutting the shape into the small rectangles along the dotted lines, and to predict the capital letter they might make if they were arranged correctly. The child wrote his predictions on a piece of white paper, drawing the possible letters to illustrate how they could be formed from the coloured paper shapes. When the child predicted several possible letters he was asked to rank order his predictions, stating which letter would be the best choice, the second choice, etc. The child was asked to give reasons for his choices, explaining how he thought the shape pieces could form his predicted letters.

Step 3: The child cut the shape into the small rectangles and arranged them in the shapes of the predicted letters, to confirm or change his original predictions. As each letter was built he was encouraged to verbalize his thoughts, e.g., "That's no good the top looks too long and heavy". The child was asked to state which letter now seemed the best choice, and to give reasons for his decision. This letter was glued on the white paper, next to the child's original predictions.

Step 4: The child progressed through four similar rectangular designs, following the procedures outlined in steps two and three.

Step 5: Each child was able to construct a letter after the shape had been cut into small pieces, and he was permitted to manipulate the small rectangles. However several children were unable to offer predictions for letters when they were shown the original design. They were then asked to write out the alphabet in capital letters, and with this assistance were able to offer predictions. In the next tutoring session they were asked to repeat the design, following steps two and three.

Step 6: Task summary: The child was asked to review the task. Questions and discussion focused on surveying the component parts of the letters, and observing spatial relationships between the parts and within the fusion of the whole letter. Prediction and verbalization, as strategies, were discussed. Several children were anxious about writing down their predictions of letters as they were concerned that their choices might be errors. Therefore prediction as a useful method of thinking out viable alternatives was discussed. Verbalization also received emphasis as some children in the group thought all their predictions could be accurate until asked to explain reasons for their choices. When verbalizing they appeared to attend to details and to spatial relationships, and were able to note inconsistencies, e.g., "This bit makes

the other part of the 'H' ... no, oh no it's far too short I know".

<u>Task Focus</u>: In completing the task the child memorially conserved the shapes of known capital letters. He preserved the spatial direction and position of the lines forming the letters, and in surveying the design, observed the relationships amongst the smaller rectangles and synthesized the parts into a spatially satisfactory whole letter.

The children's verbalizations illustrated a simultaneous processing approach to the task, with attention given to spatial relationships and a synthesis into a complete letter with balanced spatial proportions. Several children noted this final fusion or synthesis in almost the same terms as a gestalt closure,

Steven: "It's a 'T'. It looks much better than any of the other letters ... . The arm isn't too long like in the 'L' and it uses the pieces best. ... It fits."

Nicole: "It looks neat as an 'E' ... just a perfect shape."

Susan: "It just looks good ... everything goes together like an 'F' should."

Myrick: "I think 'H' ... the pieces would fit snug together. I thought it'd be an 'A' ... there'd be gaps though and it wouldn't look right."

Blain: "It had all good parts ... like balancing."

A secondary emphasis was on successive processing as the verbalization of reasons for predictions, and the task summary, placed a focus on narrative speech. However several children reported an additional strategy that appeared to rely on successive synthesis. They commented that they went through the alphabet sequentially in their minds and thought of each letter in turn to see if it was a good 'match' for the rectangular pieces.

Daniel: "I saw the shape and then I went A, B, C, and thought yes, no, no."

Shannon: "I thought of the alphabet ... the letters ... I thought of straight shapes, A, E, F. I knew there were no curves.

Though the letter construction activity did rely largely on simultaneous synthesis, successive coding was thus interwoven through the task, as the child progressed through the sequence of the alphabet and verbally reported his strategies.

Task 11: SOLID CONSTRUCTION

This task required that the child construct six solids, a pyramid, a cylinder, a cone, a cube, a rectangular prism and a triangular prism, using template designs from, "Kids Stuff Math" (Frank, 1974). The child was shown the template in two stages, first a coloured card outline, and then the outline in white card that included the dotted lines

for folding. The coloured template was presented and the child was told that a solid could be built by folding or bending the shape in certain ways. He was asked to predict the shape of a possible solid. The white template, with dotted lines to represent folds, was then presented and the child was again asked to check his previous prediction and deduce a possible solid that would result from folding in the prescribed manner. The child was then given a white piece of paper, measuring 28 cm. x 21.5 cm., containing a Xerox copy of the template design. He was asked to cut out the shape, fold along the dotted lines and construct the solid, with the purpose of confirming his prediction or changing it. Each of the six solids was constructed in this manner, and as the task was in progress the child was encouraged to verbalize the stages of construction. As each solid was completed the child was asked to compare it with previously constructed solids, e.g., base shape, faces, corners, size, curved and straight surfaces, etc. After the six shapes had been constructed, common objects, e.g., a pencil, a coffee filter, a flash cube and an icing nozzle, were assembled by the teacher. The child was asked to categorize the objects, putting each item with the geometric solid each most resembled. The child was asked to verbalize his reasons for his classification decisions.

<u>Step 1</u>: Introduction: The child's comprehension of the concept of 'solid' was checked by the presentation of several common solids, e.g., a ball, a box and an ice cream

cone, and a discussion of their attributes. The teacher demonstrated that a flat piece of card could be folded and cut to construct a small box, and the difference between a two dimensional shape and a three dimensional solid was discussed.

<u>Step 2</u>: The child was told that,

a) he would be shown several coloured shapes that could be folded or bent into three dimensional solids.

b) the shapes needed to be studied and a solid that could be formed by joining shapes appropriately, or by folding, should be predicted.

c) he would be given a white piece of paper containing the shapes and be asked to cut them out and construct the solid, with the purpose of confirming or changing his prediction.

The child was asked to explain the directions to ensure that he had understood the stages of the task.

<u>Step 3</u>: The child was shown the coloured card template of a cube, and told that the shape could be folded and built into a solid. He was asked to predict the solid that might be constructed and give reasons for his choice. Either a verbalization of the geometric title, "cube", or a description such as "Oxo cube" or "a block", was acceptable.

<u>Step 4</u>: The child was shown a white card template which indicated the dotted lines for folding. He was told that the shape could be folded along the dotted lines to form

the solid and he was asked to check his previous prediction, affirm it or change his mind. Again he was asked to verbalize his reasons.

Step 5: The child was presented with a Xerox copy of the template, and was asked to cut out the shape, fold along the dotted lines and construct the solid. The child was asked to explain his construction activity during the building process, e.g., "If I fold here, I'll get a side built". When the solid was completed discussion focused on relating previous predictions to the constructed solid, e.g., "I thought it'd be open like a box, but it's got a lid closed in".

Step 6: The child constructed each of the solids using the procedures outlined in steps three to six. As each solid was constructed it was compared to previously built solids. Verbalization was encouraged and discussion emphasized differences and similarities in shapes, sizes, corners, bases, faces, etc.

Step 7: Twenty-four common objects were assembled on the table and the child was asked to study each item and place it next to the geometric solid each most resembled. As the child assigned each object to a solid he was asked to verbalize the reasons for his decision. This final sub-task was used for review purposes. Discussion from this activity focused on similarities and differences amongst the solids and the objects. Questions and discussions also emphasized

the usefulness of prediction and verbalization as task strategies.

Task Focus: The task was designed to focus on simultaneous synthesis. The preliminary activity of surveying the template and predicting the solid was based on knowledge of spatial relationships, and especially part-whole relationships. In the categorization task the objects and solids were constantly surveyable, and the assignment of an item to a solid sub-class was centred on the child's conceptualization of spatial relationships, attending to visually apparent similarities and differences. Hence prediction of the solid from the template, construction of an appropriate solid, and comparison of common objects with the spatial features of geometric solids emphasized simultaneous processing; the integration of incoming stimuli into spatial groups. The task appeared to place a secondary emphasis on successive processing, when the child was asked to verbalize the sequential stages of the task, and provide reasons for his predictions.

The children's verbalizations appeared to indicate that they were approaching the task in a simultaneous manner. Their predictions focused on whole objects, and were usually associative:

Steven: "It's like a witch's hat." (a cone)

Brent: "A Drumstick (ice cream)." (a cone)

Michael: "A dice in snakes and ladders." (a cube)

Blain: "Bean can." (a cylinder)

Myrick: "It's a vampire's coffin." (a rectangular prism)

Russell: "I think it will look like a pop can." (a cylinder)

Ronnie: "Those greenhouses in Edmonton." (a pyramid)

Most of the children continued to make associative predictions, though after several solids had been constructed some children demonstrated that they were actively comparing the spatial relationships within the solid and amongst the previously constructed solids.

Daniel: "It's going to be .. ah well it's like two of these (pyramids) joined together." (a triangular prism)

Blain: "It'll be like that (cone) only all triangles ... like pinched straight sides." (a pyramid)

Daniel: "Another box for sure ... look it'll be long, not like that (cube), that's fat ... squares all over." (a cube)

Three children were not able to make any predictions for the first two solids, when shown the coloured card template. One child noted tentatively,

Ronnie: "It'll go along here and up,"

as he pointed with his finger along the edge of the template. The comment may suggest that he was attempting to use a successive strategy. When these children were shown the white card with the dotted fold lines indicated, they then were able to offer a prediction, suggesting that they needed to be provided with the internal spatial organization of the

solid. However after these children had constructed two solids they were then processing in a more task-appropriate, simultaneous manner.

Shannon: "I think it's a salt and pepper shaker." (a cylinder)

Michael: "A battery like a flashlight ... (Question: Could it be a car battery?) ... no, that's more like this cube."

Task 12: SHAPES AND OBJECTS (Adapted from Venger and Kholmovskaya's pre-school diagnostic test battery (1978).)

In this task the child was required to match the picture of an object with an abstract shape. Fifteen black and white line drawings of objects were mounted on individual white cards, each measuring 5 cm. x 5 cm. Three black abstract shapes were drawn on coloured card, measuring 23 cm. x 30 cm. The child was asked to sort the picture cards into the abstract shape area that each object most resembled. The activity was timed, and the child was given three opportunities to improve his speed on the sorting task.

Step 1: The coloured card, containing the three black shapes, was placed on the table in front of the child. The picture cards of objects were arranged on the table in random order. The child was told that,

a) the task was to study the picture card objects and the black shapes and sort each card below the shape each object most resembled.

b) the task would be timed.

The child was asked to explain the task to ensure that he had understood the directions.

Step 2: The child sorted each picture card into the shape category he thought it most resembled. The categorization activity was timed and the speed recorded.

Step 3: When the sorting task was completed the child was asked to provide reasons for placing each object in a particular shape category.

Step 4: If any of the objects had been classified inaccurately the child was asked to discuss the shape of the pictured object, and the outlines of the black shapes, and then to re-classify the card. Step 4 occurred quite spontaneously, as an extension of Step 3, as all the children self-corrected any errors, either when they were asked to discuss the reasons for their decisions, or when asked to describe the shape of the object in comparison to the shape of the outline they thought it most resembled.

Step 5: The pictures of the objects were once again arranged on the table in random order, and the child was asked to complete two more timed trials with the purpose of decreasing the time taken to classify the shapes and objects.

Step 6: Task summary: The child reviewed the task, with discussion and questions focusing on organized visual scanning of the spatial features of the objects and shapes, and on the usefulness of verbalizing reasons for placing objects in certain categories.

Task Focus: The task primarily focused on simultaneous processing. The child surveyed the pictured object, extracted the basic spatial features, and preserved these features whilst comparing them with the spatial relationships within the abstract black shapes. An essential component in this task was that both object and shape were constantly surveyable, and to complete the activity the child was required to synthesize the visual stimuli into spatial groups, quite rapidly. Thus the visual material presented, and the task demands for rapid integration of spatial relationships, made simultaneous synthesis the most appropriate processing approach for this activity.

No spontaneous verbalization took place during the classification task, undoubtedly due to the timed nature of the activity. Invariably the children's reasons for placing a particular object in a shape category suggested that the material was processed in a simultaneous manner, e.g.,

Myrick: "All the ones that looked like a pear ... then I put them here"(pointing to the pear-like shape).

Blain: "I put the bug in the cone-thing ... then I thought that was wrong ... it's like the guitar thing with two bumps."

The children verbalized holistic associations for the shapes and objects, indicating that they perceived them as synthesized spatial unities.

<u>Task 13</u>: <u>RELATED MEMORY SETS</u>

Twenty-eight small coloured pictures of animals were used for this task. The animals were obtained from a commercial game, "Mixi" (Schmid, Munich), and were mounted on white cards measuring 9 cm. x 4.5 cm. Each picture was divided into two equal pieces so that the animal was, in effect, a 'front half' and a 'back half', or a whole animal when the halves were pieced together.

The task was divided into two sections:

Part One: The 'back halves' of all the animal pictures were arranged on a large sheet of paper on the table. The child was asked to study the back portion of each animal and predict the name of the whole animal. The child drew the animal or wrote the name of it by the picture of the 'back half'. Then the 'front halves' were arranged, in random order, on the table. The child was asked to survey them and confirm or alter his predictions. To check the predictions the child was asked to match the front and back halves of each animal.

Part Two: The child was asked to remember and recall series of animals from a selected set of related animals, e.g., lion, tiger and cheetah. The sets increased in length from three to seven animals. The sets of three and four animals had one related characteristic or family membership. The sets of five, six and seven animals had two sub-classes, e.g., lion, tiger and cheetah (cat family), plus pheasant and parrot (bird family). As mnemonic devices titles were created, and an addition sign, made of red cardboard was used to relate the two 'titles' or key characteristics of the longer memory sets. There were three sets of three animals, five sets of four and five animals, and three sets each of six and seven animals. The child progressed from the simple three animal sets through to the more complex seven animal sets.

Part One:

Step 1: Task directions: The child was told that,

a) the picture cards arranged on the coloured paper were the back halves of animals.

b) the task was to predict the whole animal from studying the rear half.

c) the name of the predicted whole animal could be written by the back half, or the front part of the animal could be sketched and labeled.

The child was asked to explain the task to ensure that he had understood the directions.

Step 2: The child made his prediction for the total animal be drawing the whole creature or by writing the name of the animal by the back half. Spontaneous conversation was encouraged, and questions were directed to the children who did not verbalize, to ask them to give reasons for their choice. Directed questions were only necessary for three children, as most of the group was anxious to explain reasons for specific predictions, either to the teacher or their fellow class member.

Step 3: When the predictions had been made the front portions of the animals were arranged randomly on the table. The children were asked to survey them and change or confirm their previous predictions. They were encouraged to supply verbal reasons for their changes or confirmations.

Step 4: The child matched the 'front half' cards to the appropriate 'back half' cards, as a final check of predictions. The child was asked to go through his predicted list of animals and finally change or confirm his labels.

Step 5: Summary of Part 1: The child reviewed the task. Discussions and questions focused on the strategy of prediction, and the validity of confirming or changing predictions on the basis of new information. Also strategies used to effect an appropriate 'match' between both parts of the animal were discussed, e.g., spatial part to whole

relationships and visual details that served as clues. In addition verbalization as a useful organizational strategy was discussed.

Part Two:

Step 1: Task directions: The child was told that,

a) he would be asked to study a set of animal pictures.

b) the animals had something in common with each other.

c) a title, that explained the key common feature amongst the animals, should be created.

d) the animals should be remembered in their order of presentation, and recalled in the same order.

The child was asked to explain the directions to ensure that he had understood the second part of the task.

Step 2: The animal pictures were presented in order, the teacher saying, "First a caterpillar, second a grasshopper and third a spider". The child was asked to provide a title that illustrated a common group feature, or evidence of family membership, e.g., "Crawling Bugs" or "Many Legged Insects". He was then asked to review the animals in the presented order, verbalizing, "First a ..., second a ..., and third a ...".

Step 3: The cards were then covered and the child was asked to recall the animals in the correct order. If errors were made step two was repeated.

Step 4: The child progressed, using the same procedures, through the sets of three and then four animals.

On the series of five, six and seven animals the child was required to 'chunk' or group the animals by membership of two sub-families or classes. The cardboard addition sign was used as a memory aid, and two titles or key features were noted. The animals were presented in sequence and the child was asked to 'chunk' the set, and provide two brief titles, e.g., collie, hound (Title: = Dogs) and pheasant, parrot, robin (Title: = Birds). The child was then asked to verbalize, "First the two dogs, a collie and a hound, and then the three birds, a pheasant, a parrot and a robin".

Step 5: Summary of the task: The child was asked to review the steps in part two of the task. Emphasis was given to the usefulness of organized visual scanning of the animal picture sets, and the memorial strategies of chunking according to common features, selecting inclusive titles, and verbal rehearsal of the cards in sequential order.

Task Focus: The central task of recalling sets of animals in serial order was designed to focus on successive processing. The rehearsal strategy of naming, "First this, and second this", etc., focused on integrating stimuli in a successive manner, with one picture or visual stimulus serving to activate the next stimulus in the sequential chain. However several aspects of the task focused on simultaneous processing. Part one, the prediction activity, emphasized

spatial relationships, observing parts of the animal and predicting the whole from a synthesis of the relationships amongst the parts, in a manner similar to the gestalt view of closure. The second part of the prediction sub-task required the child to scan possible front parts of animals and relate, or match them mentally, to the back parts. Again the emphasis was on the integration of visual stimuli into spatial groups or wholes. Synthesis of common features to produce a title demanded close attention to the system of relationships amongst the pictured animals, and may have required a complex level of simultaneous processing (Luria, 1966, b.). Hence part one of the task appeared to emphasize simultaneous processing, and part two focused on successive processing, though simultaneous coding was interwoven through the sub-task due to the spatial nature of the visual stimuli and the synthesis of features necessary for producing a title.

The first part of the task generated an abundance of spontaneous verbalization. Most of the children vocalized or sub-vocalized the names of the predicted animals as they wrote them or sketched the front portion. One child quietly made the relevant animal noises as he wrote down his predictions. During the prediction activity the children appeared to be processing in a largely simultaneous manner, noting the part-whole relationships and integrating stimuli into spatial unities.

Blain: "The fin ... it's a whale ... no maybe it's a flipper. Yes, it's a seal." (a seal)

Steven: "Short legs and a squarish back ... could be a cow or a donkey." (a donkey)

Russell: "All that hairy ... oh look it's got to be a huskie or that lassie dog." (a collie)

Nicole: "It's a talking jungle bird with um bright ... you know all coloured feathers like a canary, only bigger." (a parrot)

Two children argued about one prediction. Their verbalization provided some insight into their processing of the task material.

Brent: "Change that one. Put whale."

Myrick: "A whale with arms? No way."

Brent: "Put whale. It looks right."

Myrick: "No. Look I'll draw in the rest of his head, like round ... whiskers, like a seal ... a funny nose and a ball on it."

Brent: "Okay, move it down and I'll finish it ... now it would look like a whale."

Myrick: "I've never seen a whale with arms."

Brent: "Flippers."

Myrick: "Okay, flippers ... look flippers that curve round ... they're not fins."

Brent: "I guess." (a seal)

Both boys had attempted to synthesize the spatial stimuli presented in the pictures into a whole. Then features were compared with their schema of the total animal. In Myrick's case the detailed features had helped to confirm his prediction, and in Brent's case had aided in modifying his prediction.

The second part of the task provided less spontaneous verbalization, though the verbalization offered did provide information on the processing strategy used to remember the animal series. Most of the children vocally, or sub-vocally, rehearsed the animals in sequential order. Several children pointed to the pictures as they were verbally reheased, and one child did not vocalize the names of the animals, but merely pointed, probably indicating that he was reviewing the order introspectively. When the children were asked to recount how they remembered the order of the animals their reponses indicated that successive strategies were being employed:

Blain: "I remember, D, S, F, O for the animals. D is dolphin, S is seal, then the F is for frog and O is otter."

Daniel: "I go lynx, then lynx, tiger, then lynx, tiger, lion."

Russell: "I draw these five brackets and I ... then I think there's an animal in each one."

Question: "How do you remember which bracket contains each animals?"

Russell: "Like one (indicating bracket one) is a parrot, two is, I think, a robin."

One or two children gave evidence of interweaving simultaneous and successive processing in their approach to the recall task:

Nicole: "I number 1, 2, 3, 4, 5. I know the animals live in holes so I think there are black holes ... like 1 is a teeny hole for the mouse, two is a bit bigger for that gopher ... three, bigger for the rabbit and four a big one for the badger."

Katherine: "I know the titles ... birds and water animals and I remember the plus (addition sign). Look three in birds and two for water ... so I think how they fit in the families."

Task 14: MEMORY FOR FACES (Using the photographs from the Kaufman Assessment Battery for Children (Kaufman, A.S., and Kaufman, N.L., 1980) sub-test, Memory for Faces).

The child was required to study a coloured photograph of one or two people, and then select the person or people from within the context of a second group photograph or series of individual photographs. Seventeen individual portraits, and eleven photographs containing two people, were

presented in the task. The portraits were mounted within oval frames on white card, measuring 28 cm. x 21.5 cm. The child was asked to study the oval portraits for a short time and then the card was removed. A second card, again measuring 28 cm. x 21.5 cm., containing a group photograph or series of individual portraits was given to the child and he was asked to identify the person, or people, from the original photograph. Sub-task one required the child to identify the single portraits and the second sub-task required identification of two people.

Step 1: The child was presented with a coloured photograph of one person and told that,

a) he should look at it carefully.

b) another photograph would be shown, and the task would be to recognize the person again within the second photograph.

The child was asked to repeat the task directions to ensure that they had been understood.

Step 2: The child was asked to examine the photograph of the person, for a maximum of ten seconds, and if he did not verbalize spontaneously he was asked to talk about anything he had noticed about the person. The portrait was then removed and the child was given the group photograph, or page of individual portraits. The child was asked to look at the second card carefully and select the person originally presented in the first photograph, giving reasons for his choice.

<u>Step 3</u>: If the child was able to identify the person in the second photograph, or page of photographs, he was presented with the next portrait in the series and the same procedure was repeated with the seventeen photographs in sub-task one.

If the child was unable to identify the correct person the original portrait was presented once again. The child was asked to describe the person, his features, clothes, expression, attitude and posture. The portrait was again removed, and the child was asked to repeat step two. This picture set was then presented to the child, once more, at the beginning of the next tutorial session.

<u>Step 4</u>: Task summary: On completion of the seventeen individual portraits the child was asked to summarize the activity. Discussion and questions focused on effective visual scanning of the whole photograph and the selection of detailed clues, e.g., a hair ribbon, a mole on the neck, earrings or a moustache.

<u>Step 5</u>: The same procedures were used with sub-task two, where the children were asked to identify two people. When the eleven photographs in this set had been completed the task was finally summarized by the child, discussion emphasizing the usefulness of visual scanning, careful clue selection, and verbalization as an aid to the organization of thoughts.

<u>Task Focus</u>: The task was designed to focus primarily on simultaneous synthesis. The child had to survey the features

of the person in the portrait, survey the second group photograph, or series of photographs, and recall the features of the original person for affirmative identification. Hence the child was required to process the visual whole, or gestalt, that the portrait presented and then look for confirming details. The children's comments from the class discussion seemed to indicate that they primarily observed visual unities.

Susan: "I looked at all the face and remembered the face and how they smile."

Myrick: "Whether they're boys or girls, fat or skinny and how their face fits in."

Michael: "I remember what they can't change, their eyes and cheeks and face ... the race of the people, like if they're Chinese."

Katherine: "He looks like my cousin."

Several children reported details:

Nicole: "He has dimples."

Susan: "Red and Yellow barrettes and she has pink."

Daniel: "His blue shirt's sticking out over his collar."

Russell: "There's three mumps (moles) on his neck."

Michael: "He's got freckles and a white face."

However in most of the pictures the people in the photographs could not be recognized by one or two isolated details, as the clothes, body position and facial features were often different in the second photograph. It seems reasonable to assume that

the children synthesized the details into an integrated 'whole' to identify the person, and that the children's short comments in this activity provided only a small sample of the processing necessary to complete the task. The narrative nature of speech placed a secondary emphasis on successive processing during the discussion and summary stages of the task.

<u>Task 15</u>: <u>TRACKING II</u> (An adaptation of a pre-school mental development assessment task (Venger, L.A. and Kholmovskaya, 1978).)

This task was an adaptation of the first tracking task, and required the child to survey a small tracking card and a map and locate a specific rectangular shape, identified by a letter of the alphabet. The child was provided with a small map of intersecting roads leading to fourteen possible locations, each indicated with an alphabet letter within a yellow rectangle. The starting point was a 'tuft of grass', as in the first tracking activity. The map was drawn on white paper (13.5 cm. x 13.5 cm.) and mounted on green card (28 cm. x 21.5 cm.). Ten tracking cards were provided, each card containing a line drawing journey from the starting point to a specific rectangle. The journeys were drawn on white paper (6 cm. x 12.5 cm.) and mounted on blue card (9 cm. x 15 cm.).

<u>Step 1</u>: The child was given the road map, the ten tracking cards and a record sheet on which to record his responses. He was told that the task was similar to the first tracking task and that:

a) each tracking card illustrated a journey from the 'tuft of grass' to a yellow rectangle.

b) each rectangle contained a letter of the alphabet.

c) he should look carefully at both the map and the tracking card and find the correct rectangle at the end of the journey. The letter in the rectangle should be written on the response sheet, e.g., card 1 = rectangle H.

d) the task was to complete all ten journey cards as rapidly as possible as the time would be recorded.

The child was asked to explain the task. If he was unable to understand the directions a sample journey card was produced and the task explained once again. Then the child was asked to explain the directions once more.

<u>Step 2</u>: The child completed the ten tracking cards by locating each rectangle and writing the letters on the answer sheet. The task was timed and the time noted on the sheet.

<u>Step 3</u>: The child's answers were checked and he was asked to explain the procedures used to complete the task. His responses were noted. If the child had made errors on any of the tracking cards he was asked to do the journey once

more, verbalizing the route as he progressed from the grass tuft to the appropriate rectangle.

Step 4: The child repeated the timed task twice more and each of his times was recorded. Between each trial he was asked to summarize the task and to explain the strategies he used to complete the cards quickly, e.g., putting the tracking card close to the map so that quick scans were possible, and observing the shapes of the roads and the spatial positions of the goal rectangles. Discussion emphasized consistent visual surveying of the map and journey cards and the necessity for good organization of task materials, i.e., the answer sheet, map and tracking cards.

Task Focus: The task appeared to focus on the integration of visual stimuli into spatial units, i.e., simultaneous synthesis. The only tracking or journey information was the shape of the journey line, and the spatial positions of the roads and the final rectangle. Hence the most effective strategy would be to process simultaneously, surveying the drawing on the tracking card and preserving the spatial relationships amongst the starting point, the road shapes and the goal location, and comparing these relationships with the visual spatial organization on the map. The descriptions of task strategies and the child's re-telling of a journey placed a minor emphasis on the successive nature of narrative speech.

No spontaneous verbalization was noted during the time trials, though in the post-task discussions several

of the children commented on the task. Their verbalizations appeared to suggest largely simultaneous processing of the task materials.

Brent: "I glance ... I look at the shapes."

Daniel: "I hold the card close up to the map and look. I keep track with my mind and one eye on each card to check the roads."

Michael: "I pretend I'm driving in a rally. I've got the maps on the car seat. I stop at the lights and can only take a quick look at the lights ... then ... vroom, vroom, I'm off on the next."

Three children recorded slow times, and did not decrease their times over two trials. Though they did not verbalize during the activity their task behaviour was observed. Each child pointed with his pencil tip or fingers on the card, and then on the map, with short, jerky movements. Myrick commented, "I need to point or I can't tell where I am. I look up a line, and across and up," suggesting that he may have been attempting to process in a successive manner. After the second trial an extra step was included for these children. The teacher gave practice with visual scanning and prediction. Random cards were held up for five seconds and the child was asked to predict the letter of the rectangle or indicate the area on the map where the journey ended. The children discovered that they did not have time to point and trace lines, and yet could achieve a high degree of accuracy

in their predictions. On the third timed trial each child was able to improve his time without decreasing in accuracy, which might indicate the adoption of the more task-appropriate simultaneous synthesis of materials.

Task 16: OVERLAPPING PICTURES (Adapted from the Overlapping Pictures sub-task in the Kaufman Assessment Battery for Children (Kaufman, A.S. and Kaufman, N.L., 1980).)

The child was shown a colourful 18 cm. x 13 cm. pictured printed on white card, and was then presented with a series of 18 cm. x 13 cm. cards, with parts of the picture reproduced on each card and parts on the card cut out. The child's task was to construct the series of partial pictures, by assembling the individual parts on top of each other, to reproduce the original picture. There were twenty-seven sets of overlapping picutres, increasing in complexity from two to seven cards in each series. The child began by reconstructing the simplest two card series and progressed towards the most complex seven card set.

Step 1: The child was presented with the first picture and the two cards that needed to be overlapped to form the picture. He was told that:

a) he needed to study the original picture.

b) the picture could be made by assembling the two cards. These cards contained only part of the

picture, and the task was to reproduce the original picture by placing one card on top of the other in an appropriate manner.

The teacher demonstrated the process by doing one overlapping picture construction with the child, who was then asked to explain the task requirements.

Step 2: The child was given each of the other three sets in the first series and asked to reconstruct the pictures. Spontaneous verbalizations were noted and at the end of the first series the child was asked to summarize the task, explaining the procedures he used to complete the picture.

Step 3: If the child made an error he was asked to correct the mistake and explain the correction. If he was unable to observe the error he was asked to study both the original picture and the reconstruction and compare the contents. Discussion focused on the spatial part-whole relationships within each picture, and any visual inconsistencies between each picture. At the beginning of the next tutorial session the child was asked to re-build the picture.

Step 4: When the four sets in the first series had been completed the original pictures were placed on the table, and the partial pictures were arranged in random order beside them. The child was asked to sort out the picture components and reconstruct each picture, alongside the original picture, as rapidly as possible. The task was timed and the

child was allowed two trials, with the objective of decreasing the time needed to complete the picture assembly. The child was encouraged to explain the procedures he used to complete the task, and the visual organizational aids used, e.g., "I sorted them into the right picture pile before I overlapped them".

Step 5: The child progressed through four sets of four pictures, four sets containing five pictures, and one set each of six and seven pictures. Steps two through four were used for each picture series.

Step 6: Task summary: The child was asked to review the task and discussion focused on the important strategy of organized visual scanning of the picture, and observation of how one part of the picture related to the whole spatially. The child was encouraged to explain the visual clues he used to complete the task, e.g., "There was no cat in the first picture", and, "the red balloon was hanging over the yellow one".

Task Focus: The task largely focused on simultaneous processing. To construct the picture the child was required to survey the sample picture and preserve the spatial part to whole relationships. The pictorial input was spatial in nature and the task requirements demanded integration of the stimuli into a spatial whole.

The children's spontaneous verbalizations during the task emphasized that they were noting part-whole relation-

ships, and synthesizing visual components and details into a total picture:

Susan: "The green balloon next to the red ... oh ... what's that bird doing there. I don't need it ... block it out."

Michael: "A girl and a boy that's all (checks the sample picture and then his own). Oh the cat ... no not the cat ... get out cat. I like it there though."

Katherine: "The raccoon playing the piano in that corner ... . Hey, he's no feet ... I'll fix that. Now his paw's missing ... . Now it's good."

Russell: "Humpty Dumpty sitting on his wall. It's good the sun's out. There it's right."

The children noted the 'rightness' or completeness of the totally constructed picture in comparison with the sample picture. This completeness could be compared with the Gestalt school's view of the 'good gestalt' or form, a harmonious spatial whole.

When the children were asked to explain how they were able to reconstruct the pictures the narrative recall of picture sequencing emphasized successive processing.

Brent: "Well first I thought he's in bed and then it's got to be night, so the stars go in ... . Then I thought he needs a rug for his feet."

Daniel: "Well I thought this kid's in it, but not the second kid, so put on the second picture ... zap ... that kid's gone, so third ... see now all of 'em."

It is not possible to make a distinction between the child's sequential recall of procedures and the actual processing that took place during the task. The task appeared to focus on the holistic spatial integration of visual stimuli, though one may suggest that successive processing was interwoven through the activity, possibly through introspective verbalization during picture construction and definitely in the overt verbalization of task recall.

Task 17: JIGSAW SHAPES

The task required the child to survey a jigsaw design of interlocking shapes (Kids' Stuff Math, Frank, 1974), and make decisions concerning spatial relationships amongst selected shapes. The child was presented with a black and white jigsaw design (16.5 cm. x 23 cm.) mounted on a blue card (21.5 cm. x 28 cm.). The jigsaw design was composed of thirty-eight interlocking shapes, each shape being labeled with a single or double letter of the alphabet, e.g., 'd' or 'dd'. Six enlarged designs, cut from orange card and exactly similar in shape to six shapes within the puzzle, were presented and the child was asked to locate the letter of the appropriate shape in the jigsaw. Fourteen questions focusing on spatial relationships, e.g., searching the whole for parts, comparing shapes and positions in space, were asked and the child's answers recorded. Emphasis was placed

on strategies for the location of parts within the whole, and making spatial comparisons amongst the parts.

Step 1: The child was shown a copy of the jigsaw design card and told that:

a) the design was made up of small shapes that lock together.

b) each small shape was labeled with a letter.

c) the first part of the task was to study the design and find certain shapes, when shown coloured card patterns of the shapes.

d) the second part of the task was to answer questions about the shapes in the puzzle.

The child was asked to explain the two aspects of the task.

Step 2: The child was shown a shape, made from orange card, and asked to locate an exactly similar shape within the jigsaw, verbalizing the letter that identified the shape. After the child had made a 'match' between the orange shape and the lettered shape in the jigsaw he was asked to explain his reasons for the choice, e.g., "Well they're both like an 'F' with an added square on the bottom". The child was presented with five more shapes and asked to verbalize reasons for the matches.

Step 3: If the child made an error in this part of the task he was asked to trace around the orange shape with his finger, and describe the shape. The child was then asked to scan the puzzle and find the matching shape, tracing

round the puzzle shape with his finger. The child was presented with the shape, later in the tutorial session, and asked to repeat step two.

Step 4: The child was asked fourteen questions about the shapes in the jigsaw designs. The questions focused on shape comparison, e.g., "Is there a shape that matches ZZ?", and positions in space, e.g., "If you flipped over MM would KK exactly match it?", and "Can B cover CC after one-half turn?". Five questions focused on shape comparisons, and nine on spatial positions. Spontaneous verbalizations were noted and the child was asked to give reasons for his responses.

Step 5: If the child made errors in step four the same tracing procedure, noted in step two, was utilized. If errors persisted the shape was cut out and the child was asked to manipulate the shape to make a match, or respond to the question. The child was asked to repeat the question later in the tutorial session.

Step 6: Task summary: The child was asked to review the tasks and summarize the procedures and methods used to complete both aspects of the activity. Discussion focused on organized visual scanning to locate parts within the whole, comparison of shapes, and the visual clues the child used to make a shape match or answer the spatial questions.

Task Focus: The task focused primarily on simultaneous processing, or the integration of visual stimuli into

spatial groups. The whole 'jigsaw' was readily surveyable throughout the task, and to complete the shape comparisons the child needed to survey the design, observe the part to whole spatial relationships and compare shapes within the whole spatial arrangement of the jigsaw. The verbalization procedures of recalling the task in sequential order, and explaining reasons for answers, focused on the successive processing involved in narrative speech. However, as the child discussed his reasons the spatial comparisons involved in making rotations, flips and turns ensured that simultaneous synthesis was woven through the activity.

The children made few spontaneous verbalizations at the beginning of the activity, but after making several comparisons and responses they became quite vocal in volunteering information as they worked on the task. Their verbalizations suggested a reliance on the task-appropriate simultaneous synthesis, as holistic associations were apparent, and observations about the 'rightness' or completeness of a spatial design were common:

Ronnie: "It looks like an F with a chip in it."

Michael: "I wonder ... yep, there's another gun."

Susan: "I funny looking E ... where are you funny looking E. You fell off a building and the end of you flipped over."

Daniel: "He's got short legs, both the same length ... so it's not that (pointing to shape V)."

Brent: "I'll find one like a stair."

Russell: "Doesn't look right. It's got to be topped like a T."

Steven: "It looks good. If you pushed it up ... look it'd fit over."

Nicole: "It's all over same ... same looks, same shape, same notches ... not too fat ... looks the same."

Task 18: SERIAL RECALL AND ASSOCIATIVE PAIRING OF PICTURES (Adapted from Kaufman, 1978).

In this task the child was asked to memorize a set of pictures of objects or animals in serial order. The pictures were black and white line drawings from "Mix and Match" (White and Rehwald, 1976) mounted on 9 cm. x 9 cm. green card. The picture cards were chosen on the basis of associative pairing, e.g., a tree and a leaf or a chair and desk, and arranged in sets of four, six and eight cards. The sets of four cards were composed of two pairs, the sets of six cards of three pairs, and the eight card series of four pairs. Four series were made for each level of complexity. Within each set the cards were arranged so that one object from each pair was in the first half of the set and the other item from the pair was in the same position in the second half, e.g., 1 - saw, 2 - tree, 3 - chair, 1 - wrench, 2 - leaf, 3 - desk. Each card in a set was numbered on the back in the order in which they were presented to the child. The child's task was to recall,

in serial order or in paired associates, each of the pictured objects in the series. The child progressed from the simplest four picture level, through to the six card, and then the more difficult eight card set.

Step 1: The child was shown the first set of four cards and told that:

a) the cards needed to be studied carefully, and as each was placed before him he should try to remember them by saying, "First ..., second ...", and so on, naming each picture.

b) the cards would be removed and he would need to recall each of the pictured objects in the correct order.

The child was asked to repeat the directions to check his understanding of the task.

Step 2: Each card from Set A was placed in front of the child, and side-by-side. The child was reminded to verbalize, "First ..., second ...," etc., if he failed to do this spontaneously.

Step 3: The cards were sequentially removed, beginning with the first card placed in front of the child.

Step 4: The child was asked to recall the pictures and the order was recorded.

Step 5: The pictures in Set A were again presented to the child and the teacher asked him to pair the items, giving reasons for each associative pair chosen.

Step 6: The child was again asked to study the series, choosing one of the strategies, i.e., either rehearsing in serial order, or in associative pairs. The child was told that he could recall the set in pairs or in serial order.

Step 7: The cards were removed by the child, either in a paired order or in serial order, and then given to the teacher. The child recalled the cards and the teacher recorded the responses.

Step 8: The cards from Set B were placed on the table, the child naming each item as it was placed before him. The child was asked to study the cards and choose whether to remember the objects in pairs or in serial order. The child then rehearsed the cards using the preferred strategy.

Step 9: The pictures were recalled using serial recall or associative pairing.

Step 10: The child worked through the remaining sets of four pictures, and then the four sets at each of the more complex levels of six and eight pictures.

If errors were made the child was asked to review the strategy he was using, and rehearse the stages of the task aloud. He was then asked to do the set again at the end of the session.

Step 11: Summary of the task: The child was asked to discuss and review strategies for memorizing items, focusing on verbal rehearsal of serial order and association of pairs or parts.

Task Focus: The sequential presentation of the picture cards, the verbal rehearsal strategy and the serial recall required of the child placed a primary emphasis on successive processing. When the child utilized the paired associate strategy, pictures were classified into groups and then recalled. The discriminations, comparisons and categorization of the visual stimuli may have involved simultaneous synthesis. However verbal or introspective rehearsal of the associated pairs re-emphasized successive processing.

The children produced a continuous flow of spontaneous verbalization during this task. Each child used overt verbal rehearsal techniques during the serial recall task, providing an indication that successive synthesis was the coding used for processing the information.

Brent: "Peach ... peach, leaf, ... peach, leaf, snowflake ..."

Daniel: "It's grapes, then grapes and lion, then grapes, lion, orange, and grapes, lion, orange, monkey."

Susan: (With four fingers extended and lowering each finger as each object was named) "Well there's a boat, then hamburger, then bus, then banana."

During the paired associate activity several children appeared to combine simultaneous and successive synthesis. They grouped the pictured objects into classes and verbalized titles that illustrated common features.

Ronnie: "Wheels (grouping a car and a bus) ... room (grouping a chair and desk) ... and shapes (grouping a triangle and circle)."

When Ronnie was asked to explain how he remembered the objects he commented,

> "Wheels, like a car and bus ... . Room, I think chair, desk ...,"

indicating an interweaving of simultaneous synthesis and the sequential ordering of successive processing.

CHAPTER FIVE

FINDINGS AND DISCUSSION

The purpose of this study was to examine the efficacy of an intervention programme, conceptualized within the simultaneous-successive model of information processing, for the remediation of a sub-group of poor readers within a learning disabled population.

Four main hypotheses were generated to test the effectiveness of the programme.

Findings Related to Hypothesis One

Hypothesis 1: Improvement in performance on the simultaneous-successive test battery will be greater for the Experimental than for the Control Group.

A Pre/Post test improvement on the simultaneous-successive battery was anticipated for both Experimental and Control Groups. However, greater improvement for the Experimental Group than the Control Group was hypothesized, due to the remediation programme that focused on task-appropriate simultaneous and successive processing strategies.

T-tests for independent samples were performed on the pre-test results of the simultaneous-successive battery.

Pre-test means and standard deviations for the Experimental and Control Groups, on each of the seven simultaneous and successive tests, are presented in Table 4. No significant differences between the means of each group, on each of the seven pre-tests was obtained (two-tailed test). However, a significant difference between groups on the Word Naming test was obtained on a one-tailed test of probability. Since Colour Naming and Word Naming both load on the speed factor (Das, Kirby and Jarman, 1979, b.) the latter test may be excluded from the study without loss of a representative test of the speed of processing. To examine pre-post test improvement, and the efficacy of intervention, a two-way analysis of variance was calculated for each of the six tests, using a 2 x 2 factorial design. Factor A was Groups, i.e., Experimental/Control, and Factor B was Test Scores over Time, i.e., Pre/Post (repeated measures). Post-test means and standard deviations are presented in Table 5. Significant main effects for Factor B (Pre/Post) were obtained for each of the tests. On Memory for Designs, Serial Recall, Free Recall and Digit Span-Forward a significant AxB interaction was obtained. Figures 1 through 4 illustrate these interactions, and Tables 6 through 11 provide a detailed account of the analyses of variance for each test. Hypothesis 1 can thus be accepted for selected tasks.

Discussion

Apart from the Control Group results on Digit Span-Forward, both Experimental and Control Groups improved their

TABLE 4

PRE-TEST MEANS AND STANDARD DEVIATIONS FOR THE SEVEN SIMULTANEOUS-SUCCESSIVE TESTS, FOR BOTH THE EXPERIMENTAL AND CONTROL GROUPS

Variables	Means		Standard Deviations	
	Exp.	Control	Exp.	Control
Memory for Designs	43.583	47.500	9.501	9.922
Figure Copying	13.250	15.500	6.326	5.18
Serial Recall	32.083	31.417	12.986	11.477
Free Recall	56.417	57.333	9.040	7.303
Digit Span-Forward	4.750	4.833	1.138	1.030
Colour Naming	36.083	36.333	5.885	4.638
Word Naming	25.333	31.667	4.376	12.608

TABLE 5

POST-TEST MEANS AND STANDARD DEVIATIONS FOR THE SEVEN SIMULTANEOUS-SUCCESSIVE TESTS, FOR BOTH THE EXPERIMENTAL AND CONTROL GROUPS

Variables	Means		Standard Deviations	
	Exp.	Control	Exp.	Control
Memory for Designs	53.000	48.583	11.394	9.209
Figure Copying	15.250	15.833	5.413	5.718
Serial Recall	45.167	32.583	10.107	9.209
Free Recall	70.083	59.417	5.632	5.583
Digit Span-Forward	6.000	4.833	1.044	0.389
Colour Naming	30.833	31.500	6.965	4.719
Word Naming	21.250	24.000	2.701	2.000

FIGURE 1

MEMORY FOR DESIGNS

Mean Scores on Pre- and Post-tests for the Experimental and Control Groups

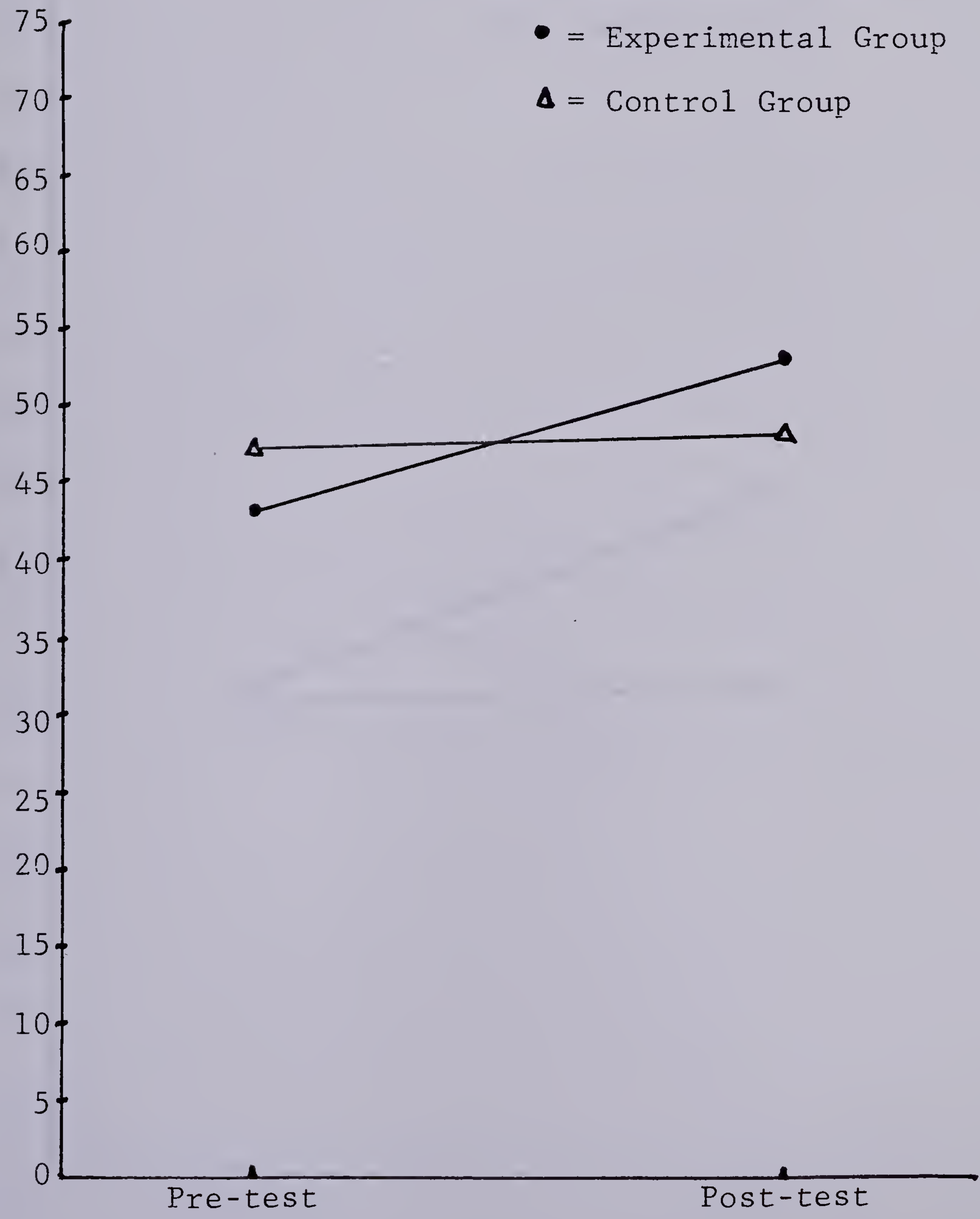


FIGURE 2

SERIAL RECALL

Mean Scores on Pre- and Post-tests for the Experimental and Control Groups

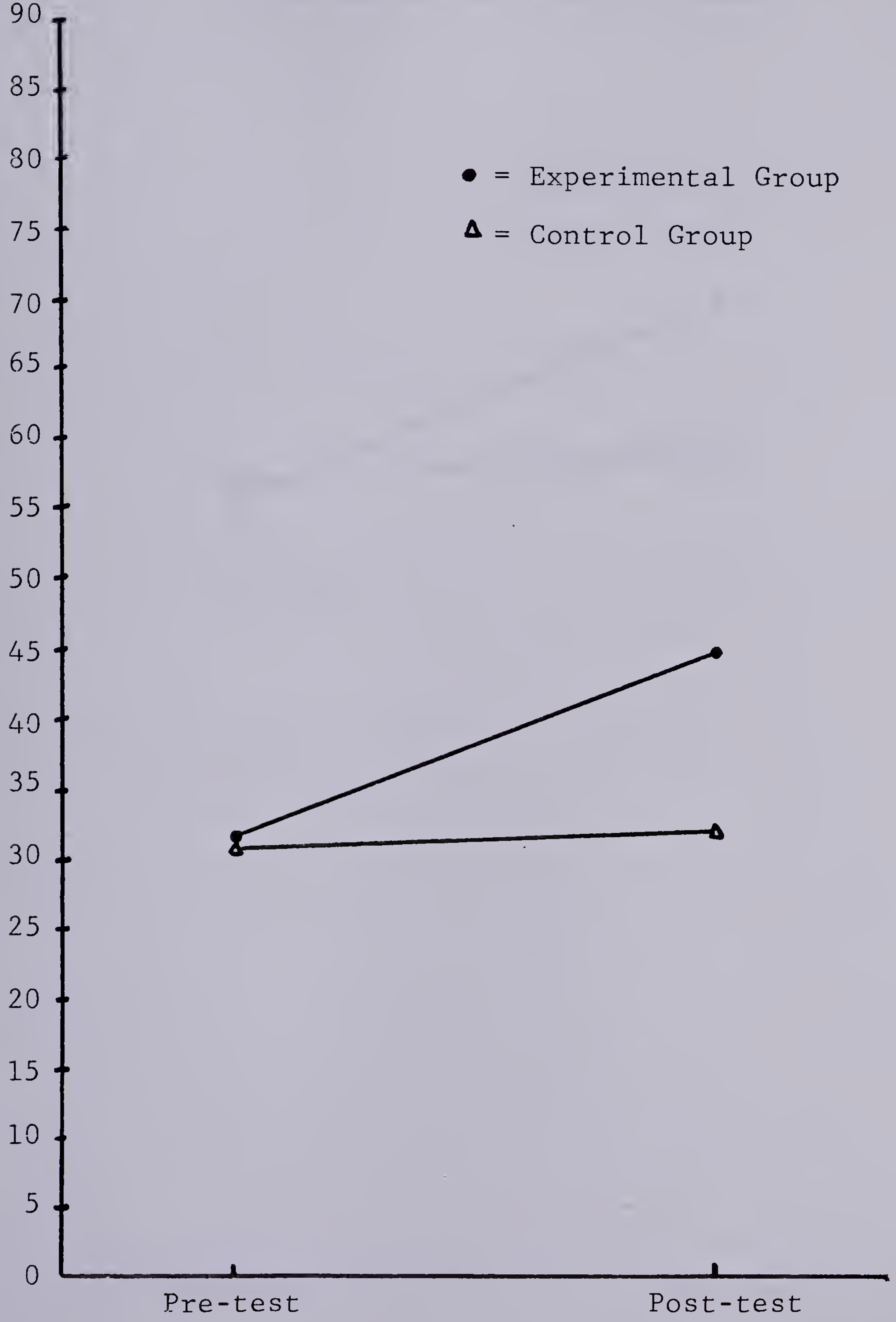


FIGURE 3

FREE RECALL

Mean Scores on Pre- and Post-tests for the Experimental and Control Groups

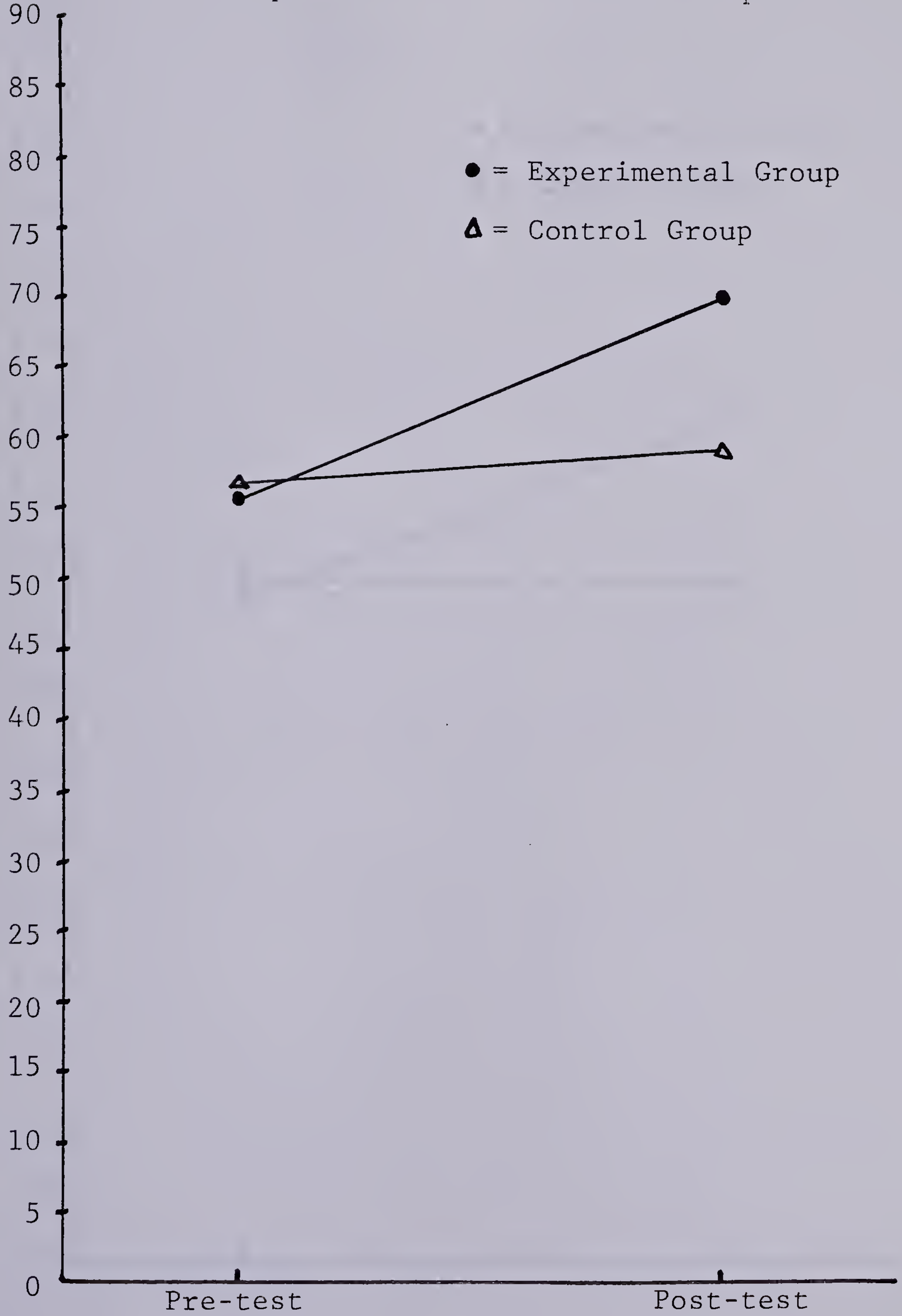


FIGURE 4

DIGIT SPAN-FORWARD

Mean Scores on Pre- and Post-tests for the Experimental and Control Groups

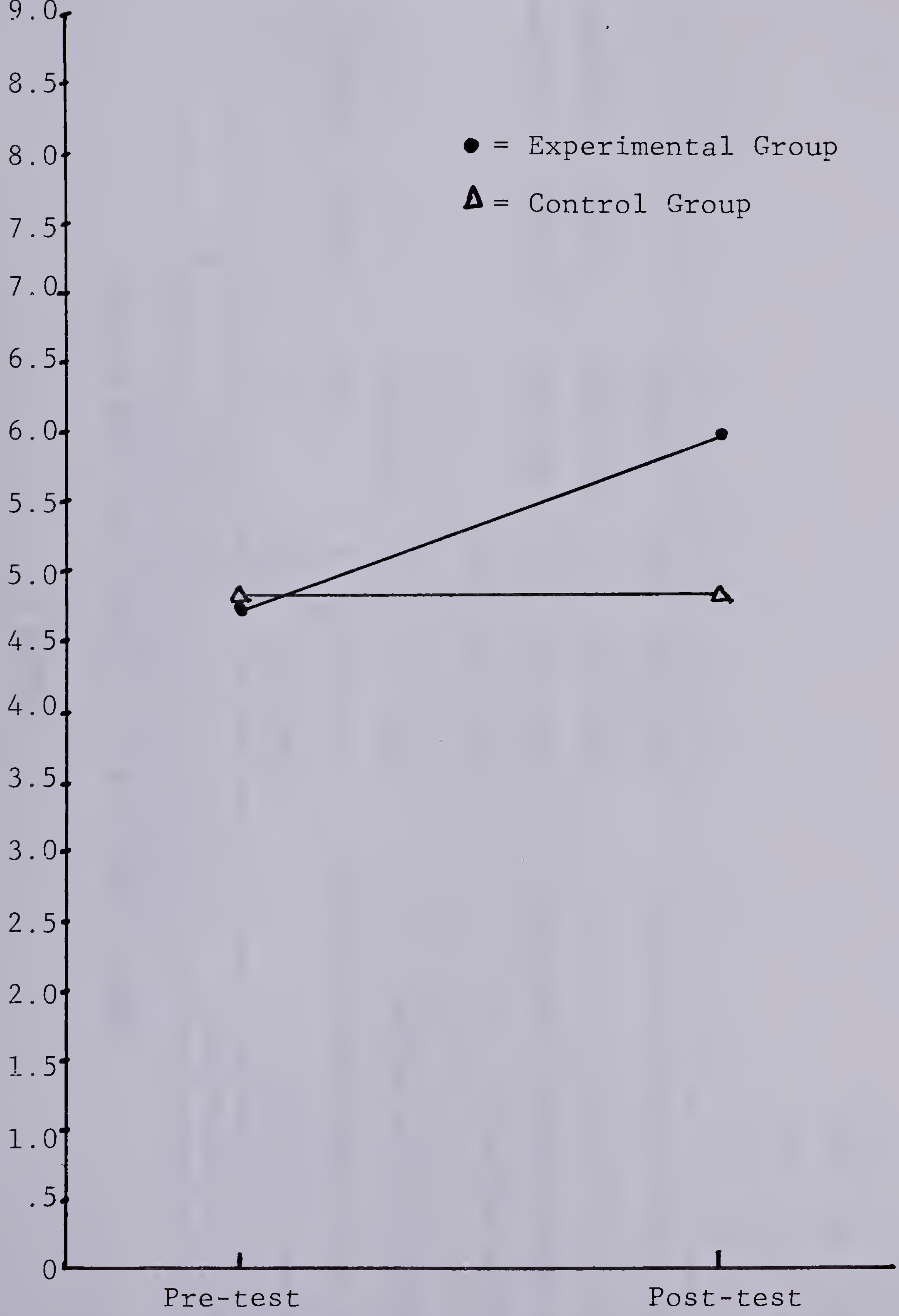


TABLE 6

TWO-WAY ANALYSIS OF VARIANCE WITH ONE FACTOR REPEATED FOR MEMORY FOR DESIGNS

Source of Variation	SS	DF	MS	F	P
Between Subjects	3846.688	23			
'A' Main Effects(Exp./Control)	0.703	1	0.703	0.004	0.950
Subject Within Groups	3845.938	22	174.815		
Within Subjects	1130.000	24			
'B' Main Effects (Pre/Post)	330.750	1	330.750	12.313	0.001***
'AxB' Interaction	208.313	1	208.313	7.755	0.010**
'B' x Subject Within Groups	590.938	22	26.861		

* = P < .05

** = P < .01

*** = P < .001

TABLE 7

TWO-WAY ANALYSIS OF VARIANCE WITH ONE FACTOR REPEATED FOR DIGIT SPAN-FORWARD

Source of Variation	SS	DF	MS	F	P
Between Subjects	27.979	23			
'A' Main Effects(Exp./Control)	3.522	1	3.522	3.168	0.088
Subject Within Groups	24.438	22	1.112		
Within Subjects	24.500	24			
'B' Main Effects(Pre/Post)	4.689	1	4.689	6.820	0.015*
'AxB' Interaction	4.686	1	4.686	6.816	0.015*
'B' x Subject Within Groups	15.125	22	0.688		

* = $P < .05$

** = $P < .01$

*** = $P < .001$

TABLE 8

TWO-WAY ANALYSIS OF VARIANCE WITH ONE FACTOR REPEATED FOR SERIAL RECALL

Source of Variation	SS	DF	MS	F	P
Between Subjects	5193.813	23			
'A' Main Effects(Exp./Control)	526.688	1	526.688	2.483	0.129
Subject Within Groups	4667.125	22	212.142		
Within Subjects	1778.500	24			
'B' Main Effects(Pre/Post)	609.188	1	609.188	19.331	0.000***
'AxB' Interaction	426.000	1	426.000	13.518	0.001***
'B' x Subject Within Groups	693.297	22	31.513		

* = P < .05

** = P < .01

*** = P < .001

TABLE 9

TWO-WAY ANALYSIS OF VARIANCE WITH ONE FACTOR REPEATED FOR FREE RECALL

Source of Variation	SS	DF	MS	F	P
Between Subjects	2013.813	23			
'A' Main Effects(Exp./Control)	285.188	1	285.188	3.630	0.069
Subject Within Groups	1728.625	22	78.574		
Within Subjects	1595.500	24			
'B' Main Effects(Pre/Post)	744.141	1	744.141	36.47	0.00 ***
'AxB' Interaction	402.469	1	402.469	19.726	0.000***
'B' x Subject Within Groups	448.875	22			

* = P < .05

** = P < .01

*** = P < .001

TABLE 10

TWO-WAY ANALYSIS OF VARIANCE WITH ONE FACTOR REPEATED FOR FIGURE COPYING

Source of Variation	SS	DF	MS	F	P
Between Subjects	1363.918	23			
'A' Main Effects (Exp./Control)	24.085	1	24.085	0.395	0.535
Subject Within Groups	1339.836	22	60.902		
Within Subjects	102.000	24			
'B' Main Effects (Pre/Post)	16.333	1	16.333	4.647	0.042*
'AxB' Interaction	8.335	1	8.335	2.371	0.137
'B' x Subject Within Groups	77.332	22	3.515		

* = $p < .05$
** = $p < .01$
*** = $p < .001$

TABLE 11

TWO-WAY ANALYSIS OF VARIANCE WITH ONE FACTOR REPEATED FOR COLOUR NAMING

Source of Variation	SS	DF	MS	F	P
Between Subjects	881.813	23			
'A' Main Effects (Exp./Control)	2.531	1	2.531	0.063	0.803
Subject Within Groups	879.297	22	39.968		
Within Subjects	822.500	24			
'B' Main Effects (Pre/Post)	305.016	1	305.016	12.980	0.001***
'AxB' Interaction	0.516	1	0.516	0.022	0.883
'B' x Subject Within Groups	516.957	22	23.498		

* = $p < .05$
** = $p < .01$
*** = $p < .001$

test scores, on each of the simultaneous-successive tests, over time (Pre/Post). The improvement was anticipated and may be attributed to maturation, a practice effect from exposure to the format of the pre-test battery, and possibly to incidental classroom exposure to tasks focusing on the appropriate utilization of simultaneous-successive processing, during the intervention phase.

The A x B interactions for Memory for Designs, Serial Recall, Free Recall and Digit Span-Forward, suggest that not all the improvement could be attributed to time, practice or incidental experience. These interactions suggest that a major portion of the improvement could be attributed to the remediation programme, as the Experimental Group Post scores indicated significantly greater improvement than did the Control Group Scores.

Although both Experimental and Control Groups demonstrated improvement on Figure Copying, the Experimental Group did not reveal significantly greater improvement than the Control Group. As Figure Copying was utilized as a test of simultaneous processing, and as remediation focused on both successive and simultaneous strategies, with an emphasis on the latter, an interaction was anticipated. Though reasons must necessarily remain speculative, suggestions may be offered in partial explanation. Figure Copying requires the child to copy fifteen geometric designs within a booklet. The child works through the booklet at his own pace, regulating his own task attention and speed. In

comparison the other simultaneous task, Memory for Designs, requires the child to attend to the designs for five seconds and then reconstruct them from memory. The tester controls the speed and focuses the child's attention for a specific time-span. The remediation programme emphasized structured tasks, where the child's attention was focused on an activity, and where there was constant attention-controlling verbal interaction with the teacher. The fifteen hour intervention programme did not include periods of time where the child regulated his own task-attention, without interaction with the teacher. It is conjectured that individual presentation of the geometric designs, by the tester, may have focused the child's attention in a manner that was comparable to the remediation procedures. It could equally be suggested that intervention should offer a transition phase, where the child is encouraged to spend longer periods of time focused on individual, but active, task participation.

Studying the test procedures of both Memory for Designs and Figure Copying, the most obvious difference is the memorial component of the former test, where the child needs to conserve the spatial relationships in order to reconstruct the designs. It may be speculated that the task of Memory for Designs may require internal verbal mediation to enable the child to reproduce the shapes in the absence of the stimuli. As verbal mediation was interwoven through the remedial programme it is suggested that this may have had a facilitative effect on the Experimental Group's Pre/Post

scores on the Memory for Designs test. In Figure Copying the stimuli were always present, and hence the child may not have seen the necessity for employing a verbal mediation strategy. This suggests the utility of continuing the remediation programme, within the resource room setting, utilizing a variety of materials and task situations to aid in the transfer of strategies, e.g., verbal mediation.

Though a main effect was obtained for Colour Naming, no interaction was obtained that may have been attributable to intervention. Remediation did not emphasize speed of processing in every activity, though several tasks, e.g., Tracking I, Tracking II and Mazes did partially focus on speed of completion. It may be suggested that though remediation included speed of processing, it did not necessarily focus on the speed of verbalization, or verbal output, emphasized in the adapted Stroop (1935) tests.

Summary

The main conclusions may be summarized as follows:

1. All the tests of successive processing, whether presented auditorially, i.e., Serial Recall and Free Recall, or visually, i.e., Digit Span-Forward, demonstrated significantly greater improvement for the Experimental Group, and this improvement is attributed to the remediation programme.
2. The greater improvement in one simultaneous test, Memory for Designs, is similarly attributed to the intervention programme.

3. Although main effects were obtained for the speed test (Colour Naming), and for one simultaneous test (Figure Copying), no significantly greater improvement was demonstrated for the Experimental Group than the Control Group, and therefore improvement cannot be attributed to the remedial programme, but rather may result from maturation, practice effects and incidental classroom exposure.

Findings Related to Hypothesis Two

Hypothesis 2: Improvement in performance on silent reading comprehension grade scores will be greater for the Experimental than the Control Group.

The comprehension sub-tests of the Gates-MacGinitie Reading Test (Level D, Forms 1 and 2) were used to test this hypothesis. A Pre/Post improvement in grade scores was anticipated for both the Experimental and Control Groups. A significantly greater improvement for the Experimental than the Control Group was hypothesized due to the strategy training programme's focus on simultaneous and successive processes. The successful integration of both processes appears to be necessary for efficient reading (Kirby and Das, 1977).

A t-test for independent samples was calculated from the pre-test grade scores on the comprehension section of the Gates-MacGinitie Reading Test (Level D, Form 1). No significant pre-test difference between the means of each group was obtained.

To examine the Pre/Post scores, and possible effectiveness of intervention, a 2 x 2 Analysis of Variance was calculated. Factor A was the Groups and Factor B was the Test scores over time, i.e., Pre/Post (repeated measures). A summary of this analysis is presented in Table 12. A significant main effect for Factor B was obtained, indicating improved grade scores for both groups over time. No significant interaction was observed. Thus Hypothesis 2 was rejected, as the Experimental Group did not achieve significantly higher reading grade scores at post-test than the Control Group.

Discussion

The Experimental and Control Groups demonstrated improved reading grade scores over time (Pre/Post). This improvement was expected and may be partially attributed to the practice effect of exposure to the pre-test format of Form 1 of the reading test, and more specifically to classroom reading programmes utilized during the interval between the administration of the pre- and post-test batteries. The comprehension section of the Gates-MacGinitie Reading Test has a multiple choice format. The child is required to read a short paragraph and respond to questions, selecting an appropriate answer from a range of four possible responses. (There is no correction factor for guessing built into this test.) All the children in the Experimental and Control groups were involved in regular, Grades 4-6 classroom reading programmes at their respective schools. These reading programmes involved

TABLE 12

TWO-WAY ANALYSIS OF VARIANCE WITH ONE FACTOR REPEATED FOR THE GATES-MACGINITIE READING TEST (COMPREHENSION SUB-TEST, LEVEL D) GRADE SCORES

Source of Variation	SS	DF	MS	F	P
Between Subjects	24.467	23			
'A' Main Effects(Exp./Control)	0.141	1	0.141	0.127	0.724
Subject Within Groups	24.326	22	1.106		
Within Subjects	31.720	24			
'B' Main Effects(Pre/Post)	17.521	1	17.521	27.249	0.000***
'AxB' Interaction	0.053	1	0.053	0.083	0.776
'B' x Subject Within Groups	14.146	22	0.643		

* = P < .05

** = P < .01

*** = P < .001

the children in using workbooks in which the silent reading of paragraphs and response to multiple choice questions were included. In addition the reading classes utilized reading kits designed by Science Research Associates. The entire format of these kits, e.g., Reading for Understanding, is composed of a series of short graded paragraphs requiring multiple choice responses. Hence it is suggested that the main effect for the Pre/Post factor may be partially attributed to the similarity of the format of the Gates-MacGinitie Reading Test, and the classroom reading experiences of the children.

Due to the intervention programme's emphasis on cognitive strategy training in processes that are presumed to underlie reading success, an interaction was anticipated. However the Experimental Group had no significantly higher reading grade scores (Pre/Post) than the Control Group. It may be suggested that the training period was too short to allow transfer of cognitive strategies from the remediation tasks to tasks of reading comprehension. However, when considering the findings of Hypothesis 4, this suggestion does not seem viable. It seems more likely that there was no significantly greater improvement for the Experimental than the Control Group on this particular sub-test of reading comprehension, due to the nature of the test's format. When working on the comprehension test the child had constant access to the paragraphs, questions, and potential answers. He was expected to regulate his own attention and progress

through the graded paragraphs at his own speed. Remediation activities always involved a constant child-teacher interaction, and the tasks were structured to make maximal use of the child's information processing strategies. The child was expected to play an active part in organizing the task materials, verbalizing the stages of the task, predicting outcomes, suggesting modifications, summarizing the results and providing reasons for the findings. Hence, it might be suggested that this comprehension sub-test, in providing constant access to the stimulus, i.e., the text, and in supplying the organization provided by the questions and possible responses, did not rely on the active organizational strategies and close child-teacher interactions emphasized in the remedial tasks. In addition the format of the test did correspond with the format of instruction in one of the resource room programmes (Control Group), where the paragraph and multiple choice approach of the Specific Skills Series (Boning, 1962-64) was used quite extensively.

Summary

The main conclusions may be summarized as follows:

1. A main effect for the Pre/Post factor was obtained, demonstrating that both the Experimental and Control Groups improved on the sub-test of reading comprehension, over time.
2. No interaction was obtained. Hence, the improvement in performance on the silent reading compre-

hension grade scores (Gates-MacGinitie Reading Test), following remediation, was not greater for the Experimental than the Control Group.

3. Pre/Post improvement for both groups was partially attributed to practice effects, and the classroom reading experiences of the children.

Findings Related to Hypothesis Three

Hypothesis 3: Improvement in silent reading instructional levels will be greater for the Experimental Group than for the Control Group.

The Standard Reading Inventory (Forms A and B) was used to test this hypothesis. A Pre/Post improvement in instructional reading level was anticipated for both groups. Reading comprehension appears to require the effective utilization of simultaneous-successive processes, with an emphasis on simultaneous synthesis for high level comprehension tasks (McLeod, 1978, Das, Kirby and Jarman, 1979 b). The intervention programme was structured to encourage the employment of task-appropriate processing strategies. Hence, the Experimental Group, through the appropriate application of simultaneous-successive processing strategies, was expected to demonstrate significantly higher Pre/Post instructional reading levels than the Control Group.

A t-test for independent samples was calculated using the instructional reading levels from the pre-test battery.

No significant difference between the means of each group was obtained.

To examine the Pre/Post improvement, and the efficacy of remediation, a 2 x 2 Analysis of Variance was calculated. A summary of this analysis is presented in Table 13. A significant main effect for Factor B was obtained, indicating improvement in reading instructional levels for both groups, over time. A significant interaction was obtained, indicating that the Experimental Group achieved significantly greater improvement in Pre/Post instructional levels than the Control Group. Figure 5 illustrates the Factor A x Factor B interaction. Therefore, Hypothesis 3 was accepted.

Discussion

Both Experimental and Control Groups improved their instructional reading levels over time (Pre/Post). This improvement was anticipated and may possibly be attributed to maturation, practice effects and the regular classroom reading programmes the children experienced during the interval between the pre- and post-test batteries.

However, the interaction obtained would indicate that not all the improvement could be explained by time, practice and classroom reading experiences. A major part of the improvement may be attributed to the remediation programme, as the Experimental Group's Post instructional levels were

TABLE 13

TWO-WAY ANALYSIS OF VARIANCE WITH ONE FACTOR REPEATED FOR READING INSTRUCTIONAL LEVELS (STANDARD READING INVENTORY)

Source of Variation	SS	DF	MS	F	P
Between Subjects	27.297	23			
'A' Main Effects(Exp./Control)	0.013	1	0.013	0.011	0.91827
Subject Within Groups	27.284	22	1.240		
Within Subjects	15.860	24			
'B' Main Effects(Pre/Post)	7.680	1	7.680	29.386	0.000***
'AxB' Interaction	2.430	1	2.430	9.297	0.005**
'B' x Subject Within Groups	5.750	22	0.261		

*   = P < .05

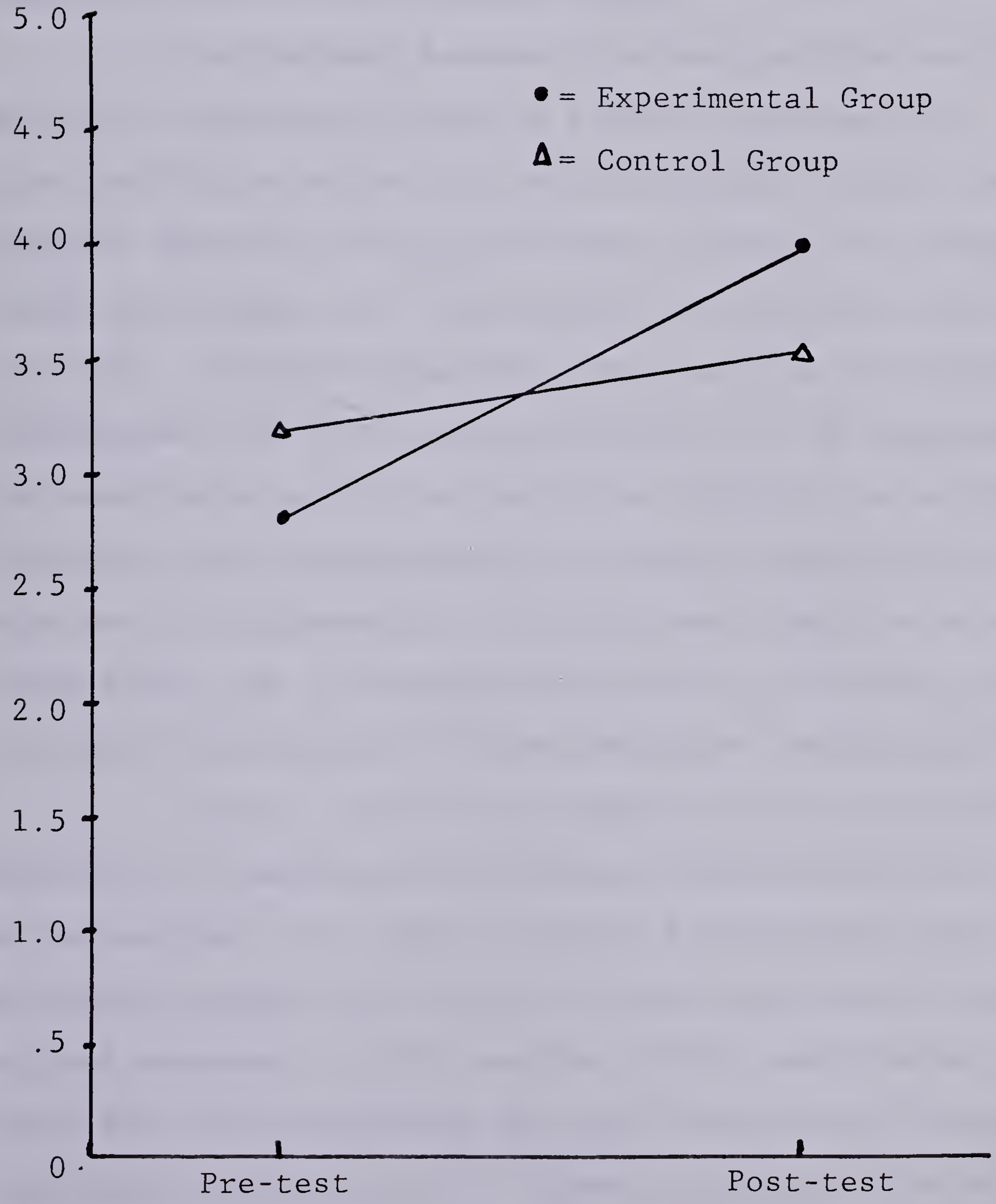
** = P < .01

*** = P < .001

FIGURE 5

INSTRUCTIONAL READING LEVELS
(Standard Reading Inventory)

Mean Scores on Pre- and Post-tests for the
Experimental and Control Groups



significantly higher than the Control Group levels. In a descriptive analysis of both groups it is interesting to observe that ten children out of twelve demonstrated improvement in instructional reading levels in the Experimental Group (Pre/Post), whereas four children out of twelve had improved levels in the Control Group.

The Standard Reading Inventory provides an alternate method of assessing children's reading comprehension. The Gates-MacGinitie relies on a multiple choice format, but the Standard Reading Inventory involves the child in reading graded paragraphs, and then asks him to verbally reconstruct the story. Directed questions are then asked to elicit information that has not been recalled. It is suggested that the remediation programme taught the child to use active strategies for the organization, coding, memorization and retrieval of information, and that these cognitive strategies are necessary for a comprehension task that requires the child to verbally reconstruct a story and answer probe questions.

Torgeson (1977) has suggested that a positive approach to remediation of learning disabled children would be the analysis of a task in terms of processing requirements, and then teaching the child to utilize the necessary task-related processes. Kirby and Das (1977), and Cummins and Das (1977), have suggested that the integration of both simultaneous and successive processes appears to be required for the task of reading comprehension. Rumelhart (1977) has observed the parallel, interactive nature of top-down

and bottom-up processes in reading comprehension proficiency, and the similarities between Rumelhart's interactive model of reading and the model of simultaneous-successive processing have previously been noted. It is therefore suggested that remediation focusing on the child's utilization of task-appropriate simultaneous and successive processing has had a facilitative effect on reading comprehension, where the latter is viewed as an interactive process.

Torgeson (1979) further suggests that learning disabled children are characterized by their failure to apply spontaneous task strategies, and that they may not have developed an awareness of their own cognitive processing strategies. The intervention programme emphasized the utilization of cognitive strategies that were appropriate for a specific task. It may be suggested that after remediation the Experimental Group children were able to generate spontaneous, and task-appropriate, simultaneous-successive strategies for the task of comprehension presented by the Standard Reading Inventory. It may also be inferred that remediation required the child's verbal interaction in predicting strategies, explaining ideas and hypothesizing outcomes, and that the ability to organize and express one's ideas clearly, is a necessary component in a comprehension task that involves story recall and verbal responses to questions.

Summary

The main conclusions may be summarized as follows:

1. A main effect for the Pre/Post factor was obtained, demonstrating that both the Experimental and Control Groups improved their instructional reading levels over time.
2. The Experimental Group demonstrated significantly greater improvement than the Control Group, and this improvement is attributed mainly to the remediation programme.

Findings Related to Hypothesis Four

Hypothesis 4a: Increase in the production of more 'text specific' (A), 'text entailed' (B), and 'text experiential' (C) semantic units within story recalls will be greater for the Experimental Group than for the Control Group.

Hypothesis 4b: Decrease in the production of 'text erroneous' (D) and 'text external' (E) semantic units within story recalls will be greater for the Experimental Group than for the Control Group.

The semantic protocol analysis (Fagan, 1980) of children's recalls of stories was used to test this hypothesis. The children's instructional level recalls from the Standard

Reading Inventory (pre- and post-tests) were subdivided into clausal units, and then each unit was assigned to one of five possible categories, A ('text specific'), B ('text entailed'), C ('text experiential'), D ('text erroneous') and E ('text external'). Out of a total of forty-eight recalls, only two clausal units were assigned to category C, and hence this category was eliminated from the data analysis as it provided so little information for the study. Each reader provided a different number of clausal units in story recall, and therefore proportion scores were calculated to indicate the proportion of information that fell into each category, for each child. For example, if a child's recall contained ten clausal units, and the units were assigned to semantic categories in the following manner: A = 7, B = 2, D = 1 and E = 0, the proportion scores would be recorded as, A = .70, B = .20, D = .10 and E = .00.

To examine the effectiveness of remediation a 2 (Factor A: Groups) x 2 (Factor B: Pre/Post) Analysis of Variance was calculated with repeated measures on Factor B for each of the dependent variables, i.e., categories A,B,D and E. The F-ratios for the Factor B (Pre/Post) main effects and the Factors A x B (Experimental/Control x Pre/Post) interactions are presented in the following table:

TABLE 14

Variables	Main Effect: Factor B (Pre/Post)		Interaction: Factors A x B	
	F-ratio	P	F-ratio	P
Category A	6.806	0.016**	0.038	0.847
Category B	2.542	0.127	1.891	0.182
Category D	1.687	0.207	1.607	0.218
Category E	0.483	0.494	0.907	0.351

A Pre/Post main effect was obtained for Category A (F = 6.806, P < .01), demonstrating that both Experimental and Control Groups had significantly declined in their production of 'textually specific' semantic units, though there was no significant A x B interaction. Figure 6 illustrates this Factor B main effect. However, no Pre/Post main effect was obtained for categories B, D and E, and there were no significant A x B interactions. Therefore Hypothesis 4a was rejected, as the Experimental Group's production of category A and B responses was not significantly higher than that of the Control Group. Hypothesis 4b was similarly rejected, as decrease in the production of category D and E responses was not significantly greater for the Experimental Group than for the Control Group.

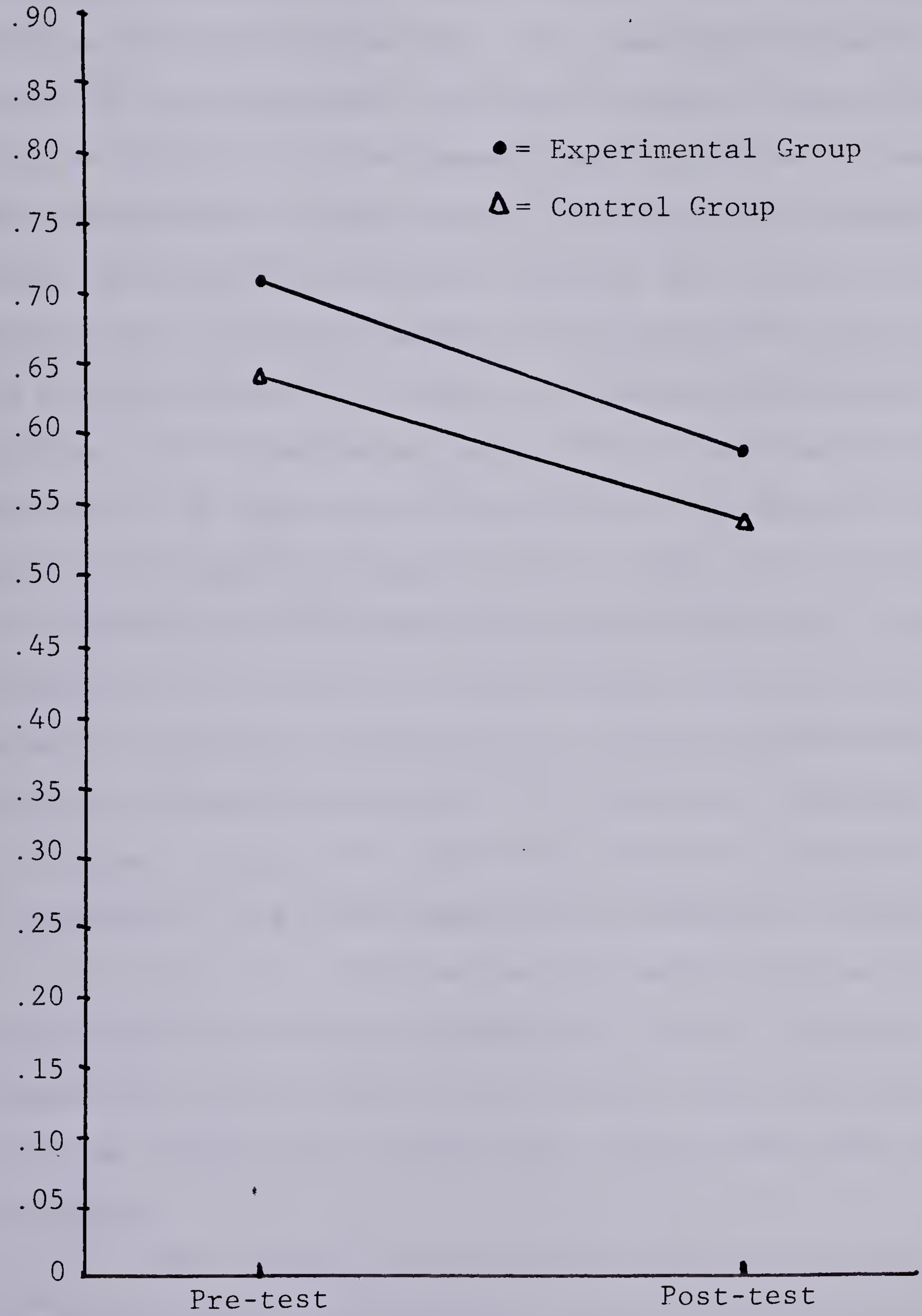
Discussion

A significantly greater Experimental than Control Group improvement was anticipated in the increased production

FIGURE 6

SEMANTIC PROTOCOL ANALYSIS

Mean Scores on Pre- and Post-tests for the Experimental and Control Groups (Category A)



of 'text specific' and 'text entailed' information, and the decreased production of 'text erroneous' and 'text external' information in story recalls. This was hypothesized on the basis of the remediation programme's focus on appropriate task strategies for simultaneous and successive processing. The integration of simultaneous and successive syntheses seems necessary for efficient reading, and children with high scores on tests loading on both processing areas appear to be high achievers in tests of reading comprehension (Kirby and Das, 1977; Cummins and Das, 1977). Simultaneous processing appears to be implicated in high level comprehension tasks, such as inferencing (McLeod, 1978). Hence, children involved in a remediation programme focusing on strategies for the appropriate utilization of simultaneous and successive coding, were anticipated to produce recalls that contained more textual information (category A), summaries, syntheses and inferences (category B), and less erroneous information (category D), and vague generalized statements (category E). This did not occur. The reasons are undoubtedly as complex as the task of reading comprehension itself, though an examination of the task of story recall and a descriptive overview of the pre- and post-test results may offer some insights.

The analysis of children's recalls of stories they have read offers the researcher partial access to the processing strategies of the child involved in a task of reading comprehension. The input, or text, and the product, or recall, are

observable, but the processing of the reader is covert. By analyzing recalls the inference is made that the information units within the recall somewhat reflect the cognitive strategies of the reader, though there is a recognized limitation in such an inference. It is acknowledged that the recall may contain only part of the known story information. That the reader is able to recall other story details effectively is evidenced when his aided comprehension score is higher than his unaided score on the Standard Reading Inventory. Thus, the researcher has available limited resources for investigating the processing strategies of the reader. The method of analyzing the product (recall), "in order to clarify the nature of the information recalled" (Fagan, 1980, p. 10), may still offer a more productive approach than solely analyzing standardized reading test scores. However, it is suggested that the method is not sufficiently sensitive to provide a 'complete picture' of the reader's processing strategies.

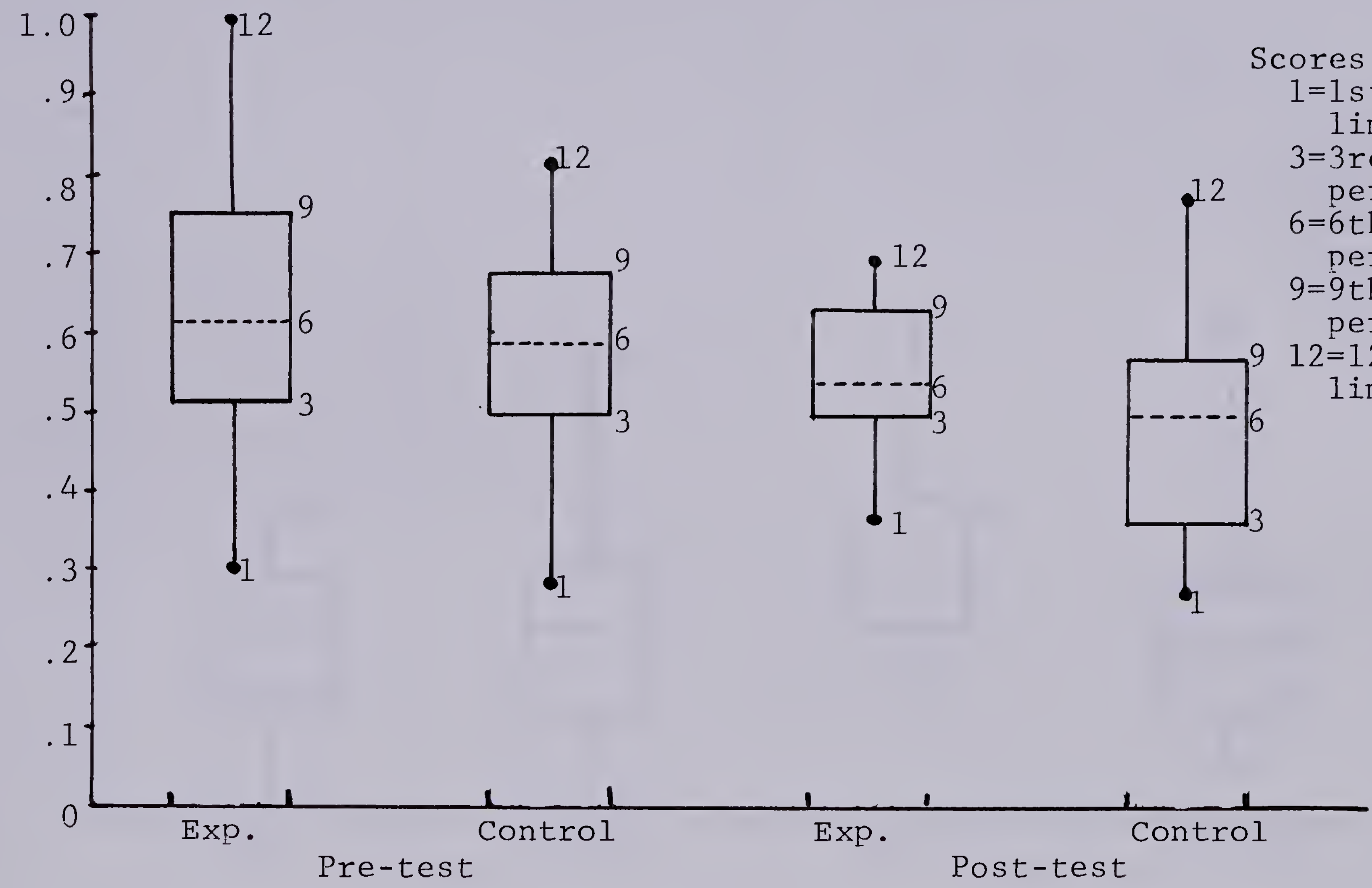
The story recalls were analyzed at the reader's instructional levels on the Standard Reading Inventory. Thus, it may also be suggested that there are no processing differences between readers at their instructional levels. Hence, differences between the Experimental and Control Groups may be seen in terms of improvement in their instructional levels on the Standard Reading Inventory. In the findings centred around Hypothesis Three it was observed that the Experimental Group demonstrated significantly greater improvement than the Control Group in their Pre/Post instructional reading

levels. This improvement was attributed to the intervention programme. It may be inferred that the Experimental Group was processing the information effectively on more difficult material in the post-test, rather than pre-test, administration of the Standard Reading Inventory.

Figures 7 through 10 illustrate the Experimental/ Control and Pre/Post-test trends. The boxes, in each diagram, contain the scores for half of the group, the lower limits of the box illustrating the third-ranked score (twenty-fifth percentile), and the upper limits representing the ninth-ranked score (seventy-fifth) percentile. The range of each group is illustrated by the positioning of the first and twelfth-ranked scores. Both groups demonstrated a significant decline in the production of 'text specific' (A) units of information (Figure 6 and 7). It may be tentatively suggested that the Experimental Group was producing less 'text specific' information, but rather more summaries, syntheses and inferences (category B: Figure 8). The Experimental Group's mean pre-test proportion score for category B was .23, the post-test score being .35. There was little difference between the Control Group's pre- and post-test means for category B, the pre-test mean proportion score being .24, and the post-test mean being .25. The Control Group produced rather more 'text erroneous' (D) and 'text external' (E) information in the post-test recalls, i.e., category D: Pre-test mean = .12, Post-test mean = .19, and category E: Pre-test mean = .03, Post-test mean = .11 (Figure 9 and 10). In

FIGURE 7

SEMANTIC PROTOCOL ANALYSIS: CATEGORY A



Scores in ranked order:
1=1st score (lower limits of range)
3=3rd score (25th percentile)
6=6th score (50th percentile)
9=9th score (75th percentile)
12=12th score (upper limits of range)

FIGURE 8

SEMANTIC PROTOCOL ANALYSIS: CATEGORY B

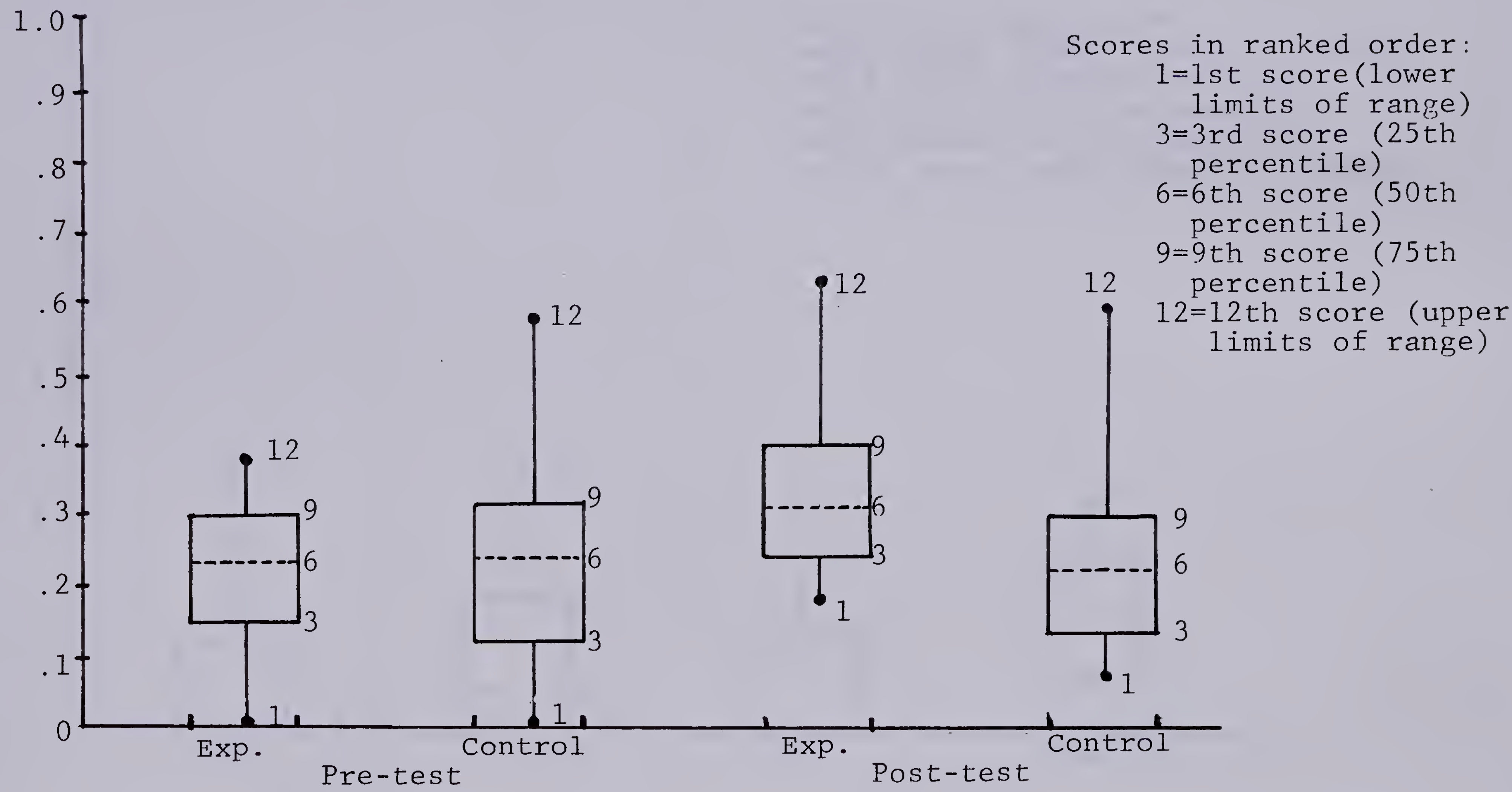


FIGURE 9

SEMANTIC PROTOCOL ANALYSIS: CATEGORY D

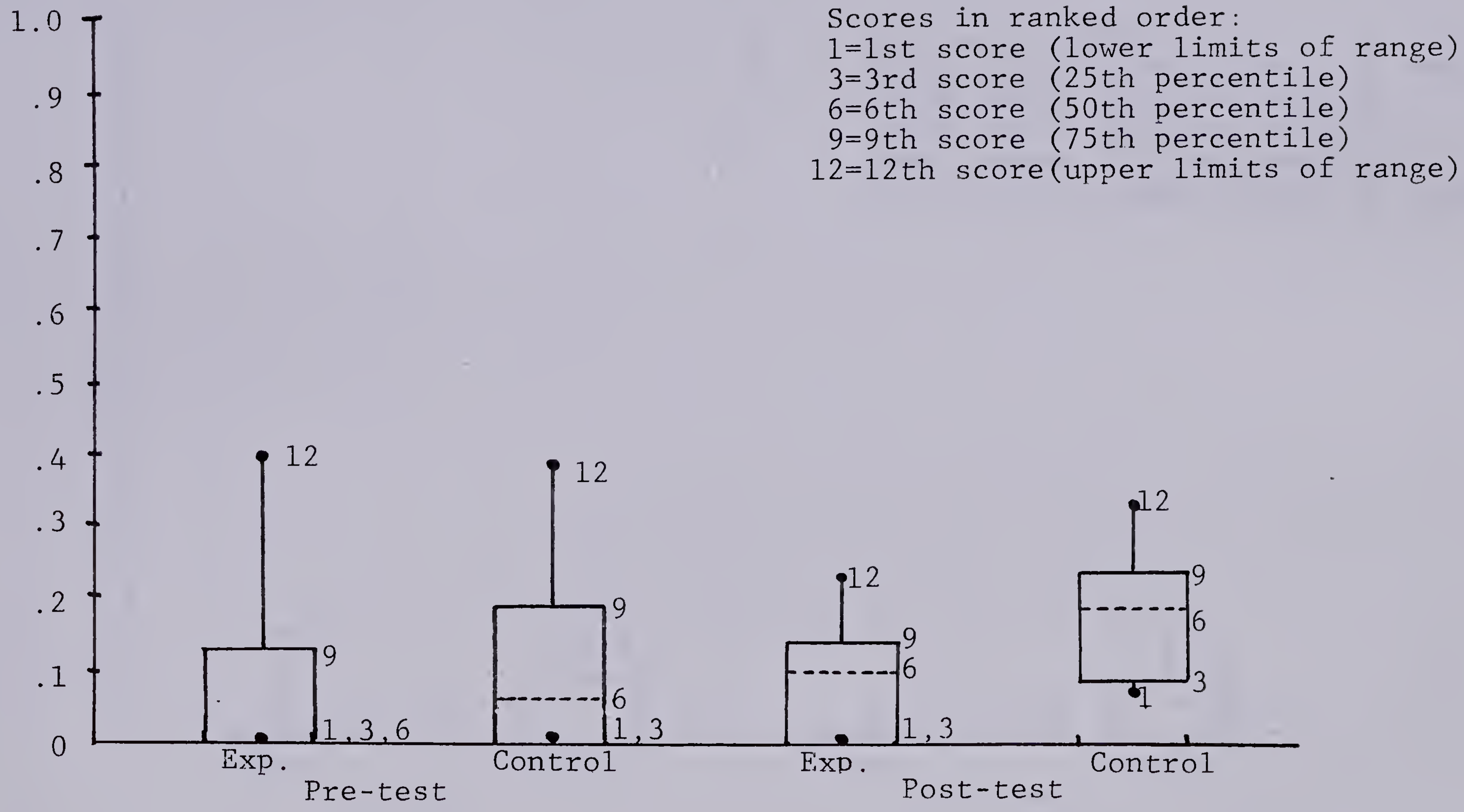
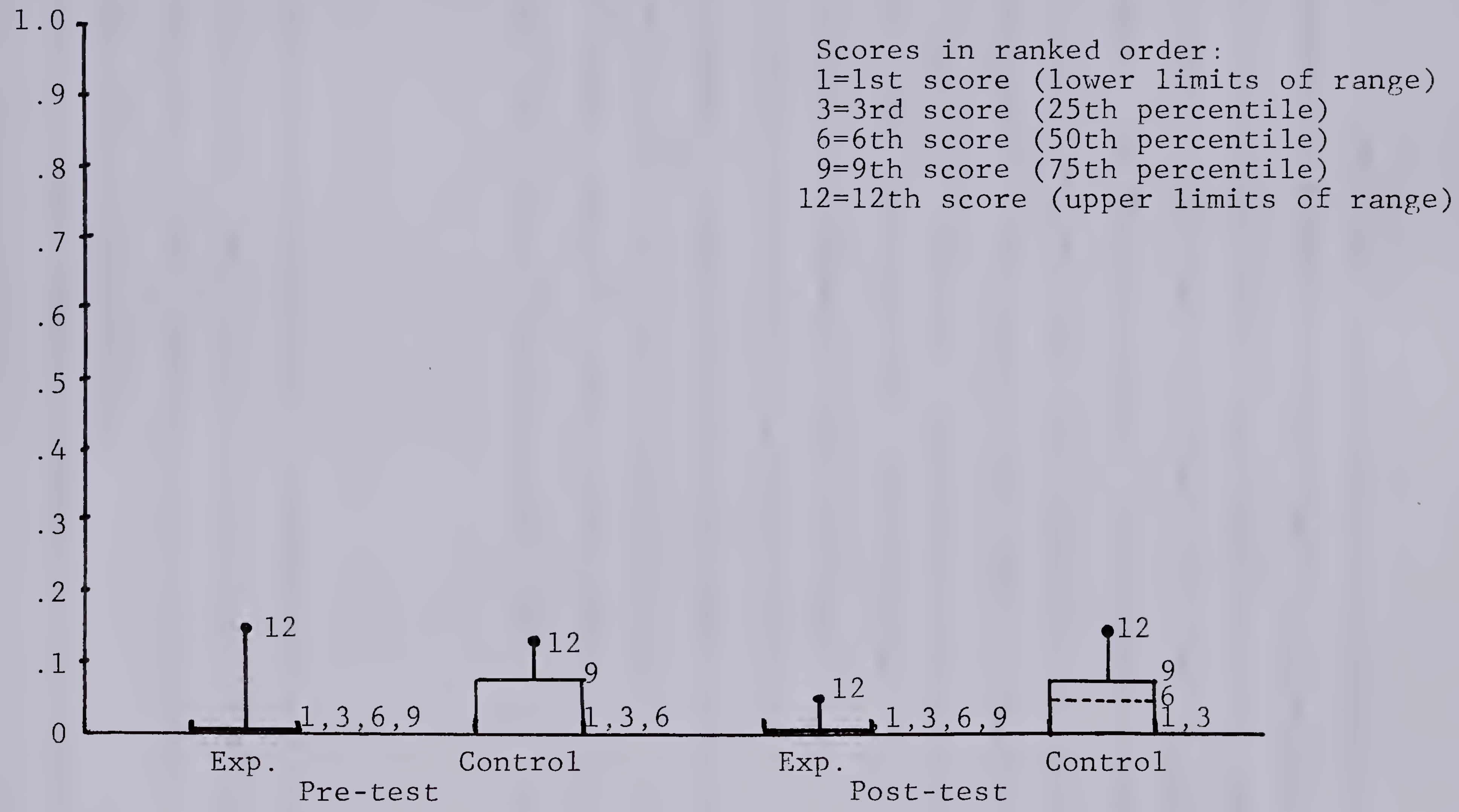


FIGURE 10

SEMANTIC PROTOCOL ANALYSIS: CATEGORY E



comparison there was almost no difference in the Experimental Group's production of 'text erroneous' and 'text external' information in the pre- and post-test recalls, i.e., category D: Pre-test mean = .09, Post-test mean - .09, and category E: Pre-test mean - .02, Post-test mean = .00 (Figures 9 and 10). Hence both groups produced less 'text specific' information, but the Experimental Group members were able to generate more 'text entailed' information, whereas the Control Group produced more 'text erroneous' and 'text external' information. However, it should be emphasized that, as there were no significant differences between the groups (Pre/Post), these descriptive comments suggest tentative observed trends that may offer some insight for the data interpretation. It is likely that larger numbers in each of the Experimental and Control Groups would have offered greater clarity for the researcher.

<u>Summary</u>

The main conclusions may be summarized as follows:

1. Both groups demonstrated a significant (Pre/Post) decline in their production of 'text specific' (A) units of information.
2. No significant Pre/Post differences were noted in the increased production of 'text entailed' (B) units of information.
3. No significant Pre/Post differences were obtained in the decreased production of 'text erroneous' (D)

and 'text external' (E) units of information, for either the Experimental or Control Group.

4. The Experimental Group did not demonstrate a significantly greater improvement than the Control Group, in the production of 'text specific' and 'text entailed' units, nor a significantly greater decline in the generation of 'text erroneous' and 'text external' units.
5. A descriptive overview of the data suggests that the Experimental Group demonstrated a trend towards the increased production of 'text entailed' information (Pre/Post), and the Control Group a trend towards the increased production of 'text erroneous' and 'text external' information. Larger numbers in each group may have increased the clarity of this tentative observation.

CHAPTER SIX

CONCLUSION

A recent approach in research has been the isolation of educationally significant sub-groups, from the somewhat heterogeneous population of learning disabled students (Rutter, 1978). This study delineated a sub-group of poor readers, in a nine to twelve year old age group, who were experiencing severe difficulties in reading comprehension (below the thirty-fifth percentile on the Gates-MacGinitie Reading Test) and yet were above 85 I.Q. Torgeson (1977) provided guidelines for studying children with learning difficulties in relation to their area of specific task failure. He suggested an analysis of the task in terms of the processing demands it placed on the child. Within this study, the task of reading comprehension has been examined in terms of the processing demands placed on the reader. Utilizing Das et al's model (1973 a , 1973 b , 1975, 1979 a , 1979 b), which is embedded in Luria's (1966 a , 1966 b , 1973) theories, simultaneous and successive processes (and planning behaviour) have been conceptualized as being implicated in every act of information processing, including the active reconstruction of meaning involved in tasks of reading comprehension. A remediation programme was designed to train the task-appropriate use of simultaneous and

successive processes, with the purpose of improving the reading comprehension of the learning disabled sub-group. The general objective was to teach the children 'how to learn', by emphasizing the training of cognitive strategies for tasks that focused on simultaneous and successive coding, by encouraging the active participation of the child, and by asking him to regulate his actions through conscious use of verbal mediation. Transfer of cognitive strategies to tasks of reading comprehension was anticipated. To test the effectiveness of the remediation programme, the sub-group of learning disabled children was divided into an Experimental Group who received strategy training, and a Control Group who received remedial reading instruction in a learning resource room. The intervention phase involved fifteen hours of instruction in either strategy training or remedial reading. Pre- and post-test results on tests of simultaneous-successive processing and reading comprehension were analyzed to test the effectiveness of intervention.

The main findings of the study indicated that the strategy training programme was successful in producing greater Experimental than Control Group improvement on four tests of simultaneous and successive synthesis, and on instructional reading levels (as measured by the Standard Reading Inventory). It could be suggested that the Experimental Group was able to transfer the cognitive strategies, utilized for tasks focusing on simultaneous-successive processing, to a task of reading comprehension. Although the results have

been interpreted within the framework of the simultaneous and successive model, the complexity of human information processing is acknowledged. Other theoretical perspectives may offer insight in their alternate perceptions of aspects of the remedial activities, for example Paivio's (1971) explanation of visual imagery and learning, and Meichenbaum and Goodman's (1971) description of generalized learning emerging from training in the use of verbal mediation. Within the present study verbal mediation was interwoven through the cognitive strategy training programme. Future research may explore the contribution of verbal mediation to remediation, by structuring a study within the simultaneous-successive information processing theory, and offering groups of children maximum and minimum verbal mediation training conditions.

Inclusion of a strategy training programme may prove to be an invaluable component within the resource room. Such a programme would teach strategies so that the children are encouraged to "employ the optimal processes in a task" (Das, Kirby and Jarman, 1979 b , p. 86). The remediation would, thus, not focus on training processes alone, but on task-appropriate utilization of processes. An important aspect would be eliciting the child's conscious use of the strategies by discussing the procedures, summarizing the task, and predicting future task approaches. Stimulating cognitive awareness of appropriate strategies could be considered a keystone of remediation. Sternberg, Ketron and Powell (1980) affirm the viability of teaching people

how to learn:

> We believe that people's quality of metacognitive information might be measurably improved by training the people in a particular strategy, and then by pointing out to them how this strategy differs (if at all) from the strategy either that is ideal for the task (on the average) or that people use spontaneously when they are untrained. ... Ultimately, we hope it will be possible to train people in ways that will make them truly "more intelligent" (p. 25).

"More intelligent" for Sternberg, Ketron and Powell (1980) does not necessarily mean improved scores on traditional, psychometric intelligence tests, but emphasizes the processes and strategies used in intelligent behaviour. The strategy training they suggest emphasizes teaching conscious behaviour, making subjects aware of task-appropriate strategies and comparing their merits through verbal interaction. The remediation programme, in this study, was designed to stimulate "more intelligent" behaviour, in terms of training cognitive strategies that could be utilized for tasks of reading comprehension. The findings of this study would suggest the utility of devising remediation programmes, within the same framework, for the sub-group of learning disabled students experiencing difficulties with reading comprehension.

However, additions to the programme utilized in this study, may be suggested. Based on the present and previous studies (Krywaniuk, 1974; Kaufman, 1978) fifteen hours of remediation might be considered a minimum time requirement, and a longer training programme is suggested to facilitate

generalization to academic tasks. As verbal interaction is a necessary component of intervention the small groups within the resource room may make this setting the most appropriate for initial intervention. The strategy training programme could be encompassed within the learning resource programme, so that the children received daily remediation throughout the school year. A transition phase is also recommended, where the children are provided with the opportunity of transferring the cognitive strategies to a variety of academically-related tasks. The teacher would be required to be aware of the processing demands each task placed on the child, and discuss the relative merits of task-appropriate strategies.

Future research could include training resource room teachers to utilize cognitive strategy training procedures, and investigating the effectiveness of year-long programmes in terms of improved performance in specific academic task areas, e.g., reading comprehension. It may also be productive to investigate the long-term effects of strategy training by re-testing children no longer receiving remedial instruction, at suitable time intervals after leaving the programme, e.g., three months, six months and a year. An interesting question addressed to future research in reading comprehension, remains unclarified:

> Are there any pre/post remedial processing differences between the Experimental and Control Groups, as reflected by the nature of the information recalled at their instructional reading levels?

The findings of this study would suggest that the Experimental Group demonstrated greater improvement in instructional reading levels, than the Control Group, but that there were no significant processing differences between the groups in the quality of the story information recalled. However trends were observed, namely that the Experimental Group produced more 'text entailed' information (Pre/Post), and the Control Group produced more 'text erroneous' and 'text external' information (Pre/Post). Larger numbers in the groups may serve to offer more clarity in this issue.

Spache (1976) levels a criticism against our present school-based remediation programmes for children experiencing difficulties in reading:

> The manner in which remedial services for learning disabilities are established is often a rather unscientific and unplanned procedure (p. 350).

It is suggested that the intervention procedures outlined in this study, offer a structured, planned approach to learning, developed within a theoretical framework, and as such may provide a viable addition to resource room programmes.

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APPENDIX: A

THE TESTS

Memory for Designs

Test instructions given to the child:

I am going to show you some cards with drawings on them. I will let you look at a card for five seconds. Then, I will take it away and let you draw, from memory, the design you have seen. Be sure to look at the drawing carefully so that you can make yours just like it. Don't start to draw until I take the card away. Ready? Here's the first one.

Nine examples of the designs used in the test are given below.

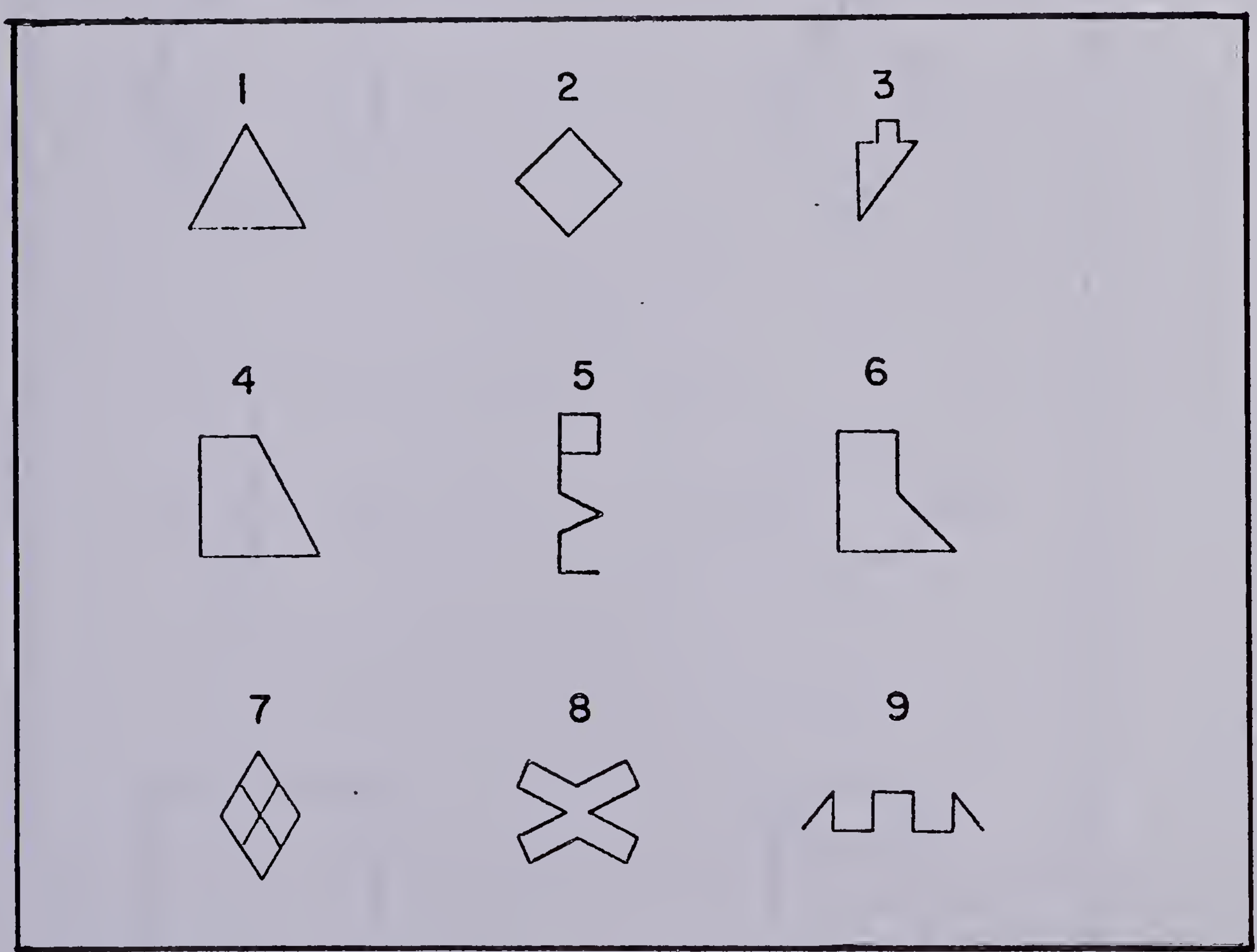
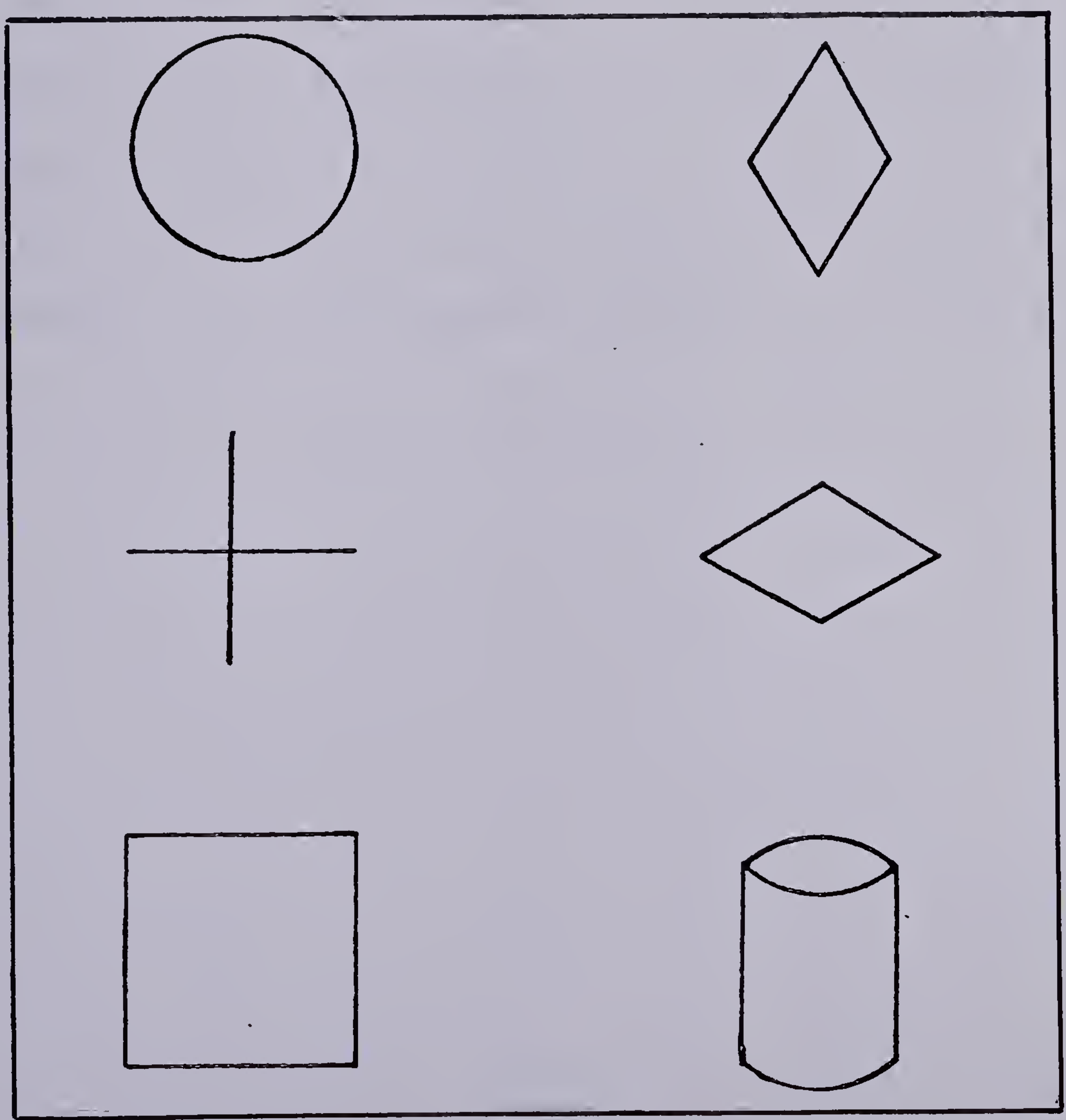


Figure Copying

Test instructions given to each child:

I am going to give you a booklet with fifteen designs in it. There is one design at the top of each page and a blank space beneath. I want you to copy each design in the blank space provided, as carefully and accurately as you can. Try to make your drawing look just like the one at the top of the page. Ready? Good, then begin.

Six examples of the designs used in the test are given below:



Digit Span - Forward (visual presentation)

Test instructions given to the child:

I am going to show you some sets of numbers. The numbers will appear one at a time in this window. Watch the numbers carefully, and then tell me them in the order that you saw them. Ready? This is the first set of numbers.

Number sets for Digit Span - Forward are given below:

	Series One	Series Two
Set one:	5 8 2	6 9 4
Set two:	6 4 3 9	7 2 8 6
Set three:	4 2 7 3 1	7 5 8 3 6
Set four:	6 1 9 4 7 3	3 9 2 4 8 7
Set five:	5 9 1 7 4 2 8	4 1 7 9 3 8 6
Set six:	5 8 1 9 2 6 4 7	3 8 2 9 5 1 7 4
Set seven:	2 7 5 8 6 2 5 8 4	7 1 3 9 4 2 5 6 8

Serial Recall and Free Recall (auditory presentation)

Test instructions given to the child:

I am going to say some words. When I am finished I want you to say the words just the way I said them. Let's try a group of words. Ready? 'big, long, great, tall'. Tell me the words. (Pause.) Good/You should have said 'big, long, great, tall'. (Either begin testing here, or give further examples.) Now let's try some other groups of words. Ready?

Word sets for Serial Recall and Free Recall are given below:

1. tall, long, big, huge.
2. high, tall, fat, big.
3. day, cow, wall, bar.
4. key, few, hot, book.
5. book, far, wall, hot, mat.
6. wide, tall, large, huge, broad.
7. long, big, great, wide, fat.
8. few, pen, hot, wall, bar.
9. key, not, cow, pen, wall, book.
10. wide, large, big, high, tall, vast.
11. long, big, fat, great, large, huge.
12. pen, wall, book, key, cow, hot.
13. high, fat, huge, wide, long, large, broad.
14. day, key, cow, bar, wall, few, hot.
15. great, high, tall, long, big, broad, fat.
16. cow, day, bar, wall, few, mat, ket.

Colour Naming

Test instructions given to the child:

(First present the child with a small chart with the four colour strips in red, green, yellow and blue glued on it. Check that the child can name the colours.)

I have a chart, and on it are different coloured strips of paper. When I lift the cover I want you to start here at the top left, (point) and name the colours across the top row. When you finish that row, go here (point to the left side of the second row) and work across. Name all the colours in this way (point along each row, progressing down the chart). You will be timed, so name the colours as quickly as you can. Are you ready? (Lift the cover.) Begin. (Start stopwatch).

The colour naming chart is given below: (Words replace the coloured strips in this example.)

red	green	yellow	green	blue
green	blue	yellow	red	blue
blue	green	red	yellow	red
yellow	red	blue	green	yellow
blue	yellow	red	blue	green
yellow	red	green	yellow	blue
blue	green	red	yellow	green
red	yellow	blue	green	red

Word Naming

Test instructions given to the child:

(First present the child with a small chart with the words red, green, blue and yellow printed on it. Check that the child is able to read the words.)

I have a chart, and on it are the names of different colours. When I lift the cover I want you to start here, at the top left, (point) and read the words across the top row. When you finish that row, go here (point to the left side of the second row) and work across. Read all the words in this way (point along each row, progressing down the chart). You will be timed, so read the words as quickly as you can. Are you ready? (Lift the cover.) Begin. (Start stopwatch.)

The word naming chart is given below:

green	blue	yellow	red	green
red	red	yellow	green	blue
green	red	blue	green	yellow
yellow	blue	green	yellow	red
blue	green	yellow	red	blue
green	yellow	red	blue	red
yellow	red	yellow	green	blue
red	blue	green	yellow	red

[illegible]

The Gates-MacGinitie Reading Test

A sample passage, with accompanying questions, is presented below:

Daria was about seven years old, her playtimes became shorter and she took over some of the work of the household. In planting and harvest time, she worked in the fields near her African village. When she was fourteen, she would be expected to know all about separating the cotton from the seed and rolling it out into thread.

1. When Daria was about seven, she began to play

   A. house C. with new friends

   B. less D. in the fields

2. The story says that, at fourteen, Daria would need to know how to

   E. weave cloth G. make thread

   F. cook meals H. run a household

(Passage one: Form D, Level 1)

Standard Reading Inventory

Test instructions given to the child:

I am going to give you some short stories to read. When you finish reading a story I want you to tell me what you have read. You may take as long as you want to read each story. I will record how long you take.

This story is called ... (give exact story title). Read the story silently and tell me about ... (say the title once more), when you have finished. (Hand the story to the child.)

The Standard Reading Inventory

A sample passage, with the accompanying directed questions, is presented below:

A Gift

Henry was delighted when his parents gave him a camera. He darted out of the house immediately and looked for something to take a picture. He saw a soldier on horseback and took his picture. He took another of a policeman near the traffic light. He was so excited and so interested that he forgot it was lunch time. Henry was hungry so he hurried home. When he got there his father and mother howled with laughter. They told Henry there was no film in the camera. Henry felt foolish.

____ 1. How did Henry feel?

____ 2. Who gave him the gift?

____ 3. What did he get?

____ 4. What did he do?

____ 5. What did he take a picture of?

____ 6. What else?

____ 7. Why did he go home?

____ 8. What did his parents do?

____ 9. Why did they laugh?

____ 10. How did Henry Feel?

Comprehension unaided ________: Total (aided) __________

(Passage 3^2: Form A)

APPENDIX: B

THE TASKS

Task illustrations, listed in order of presentation to the child:-

Task 1: TRACKING

Task 2: MAGIC WINDOW

Task 3: SHAPE DESIGN

Task 4: MATRIX LETTER

Task 5: MATRIX NUMBERS

Task 6: PICTURE STORY ARRANGEMENT

Task 7: COMMUNITY PUZZLE

Task 8: MAZES

Task 9: TRANSPORTATION MATRICES

Task 10: LETTER CONSTRUCTION

Task 11: SOLID CONSTRUCTION

Task 12: SHAPES AND OBJECTS

Task 13: RELATED MEMORY SETS

Task 14: MEMORY FOR FACES

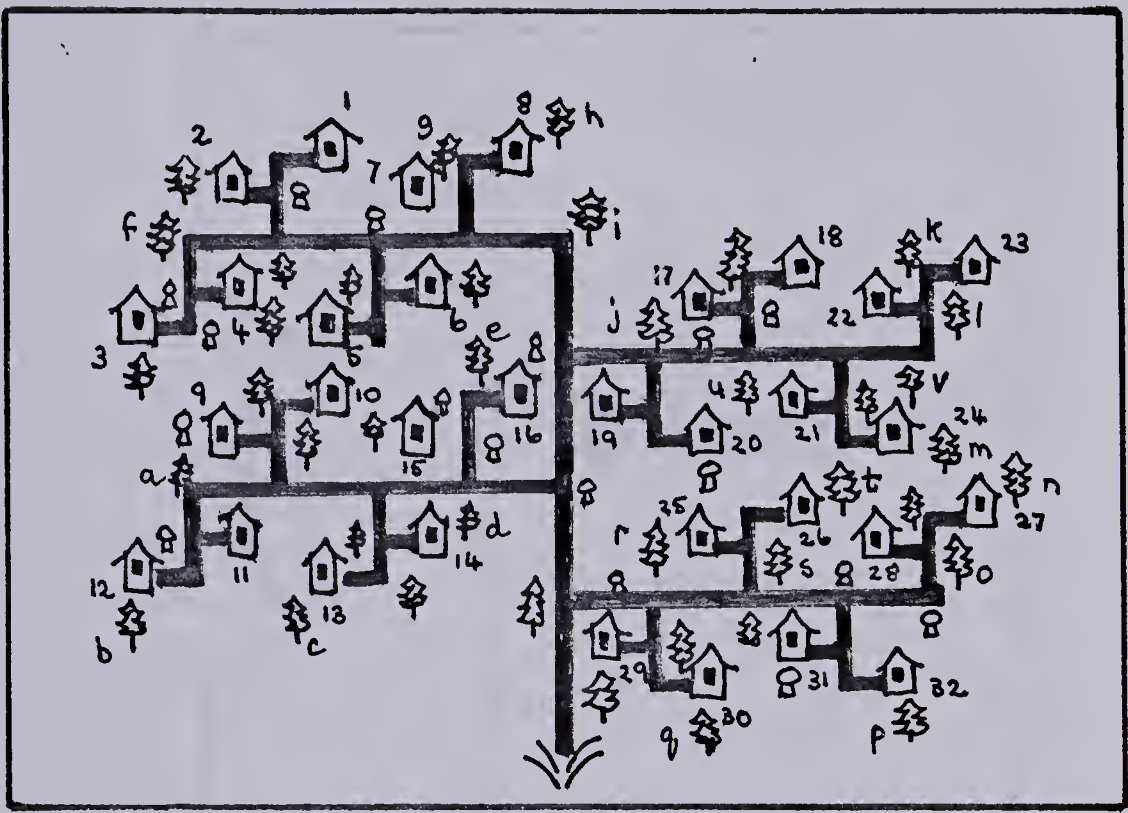
Task 15: TRACKING II

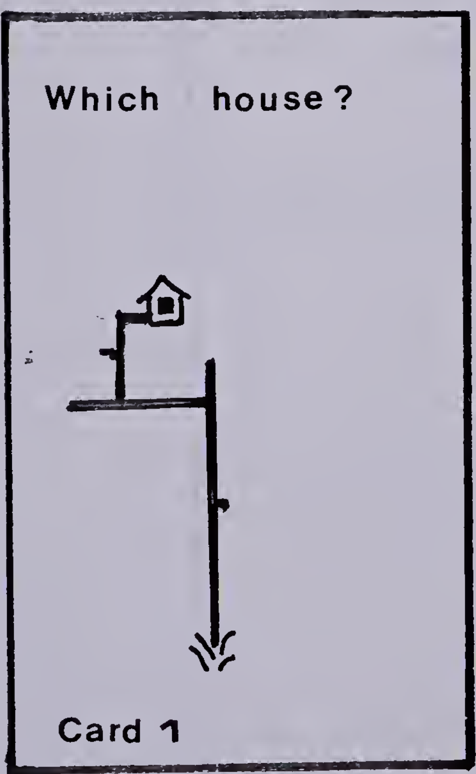
Task 16: OVERLAPPING PICTURES

Task 17: JIGSAW SHAPES

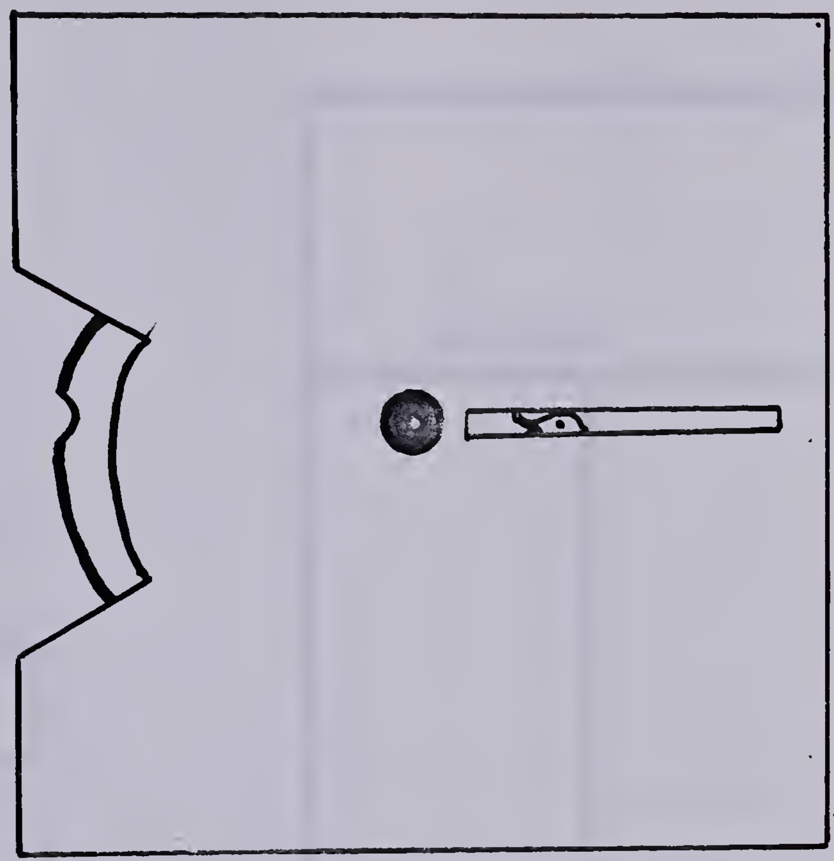
Task 18: SERIAL RECALL AND ASSOCIATIVE PAIRING

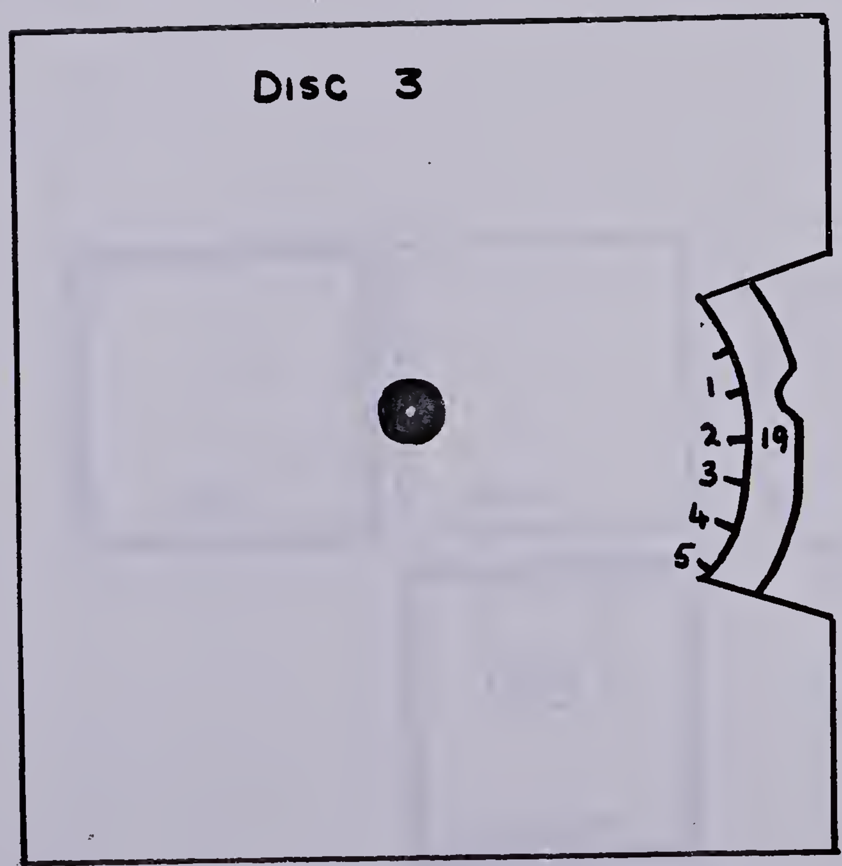
TASK 1 : TRACKING



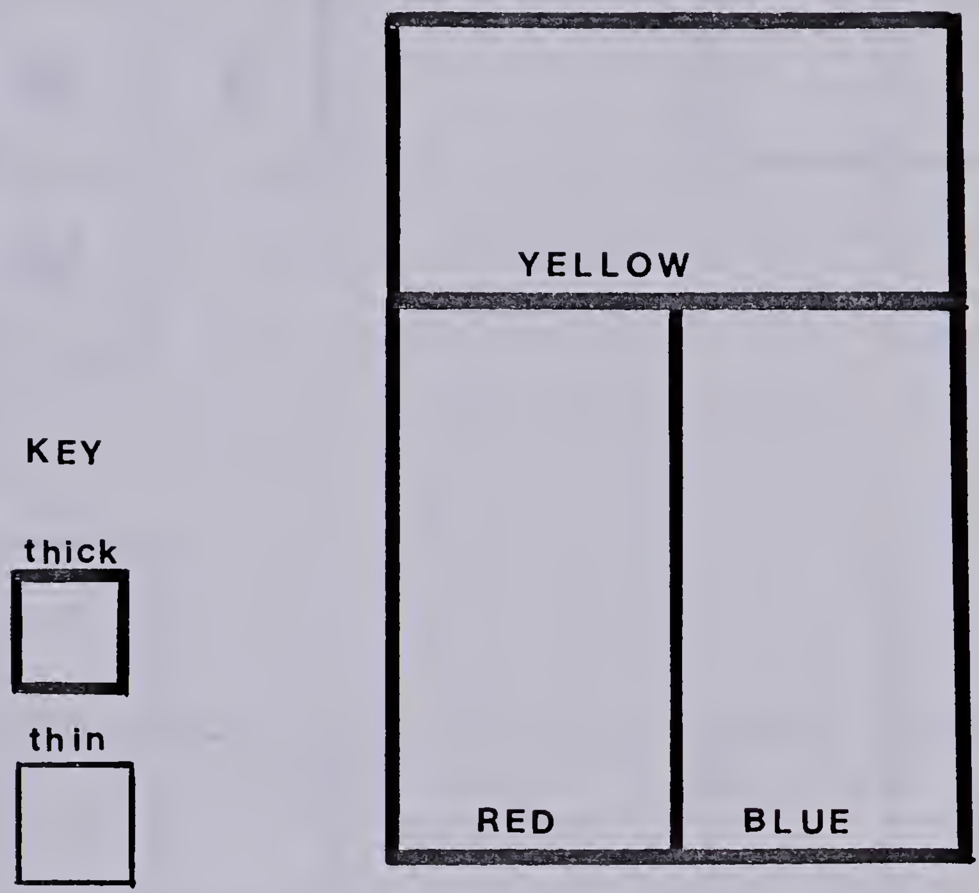


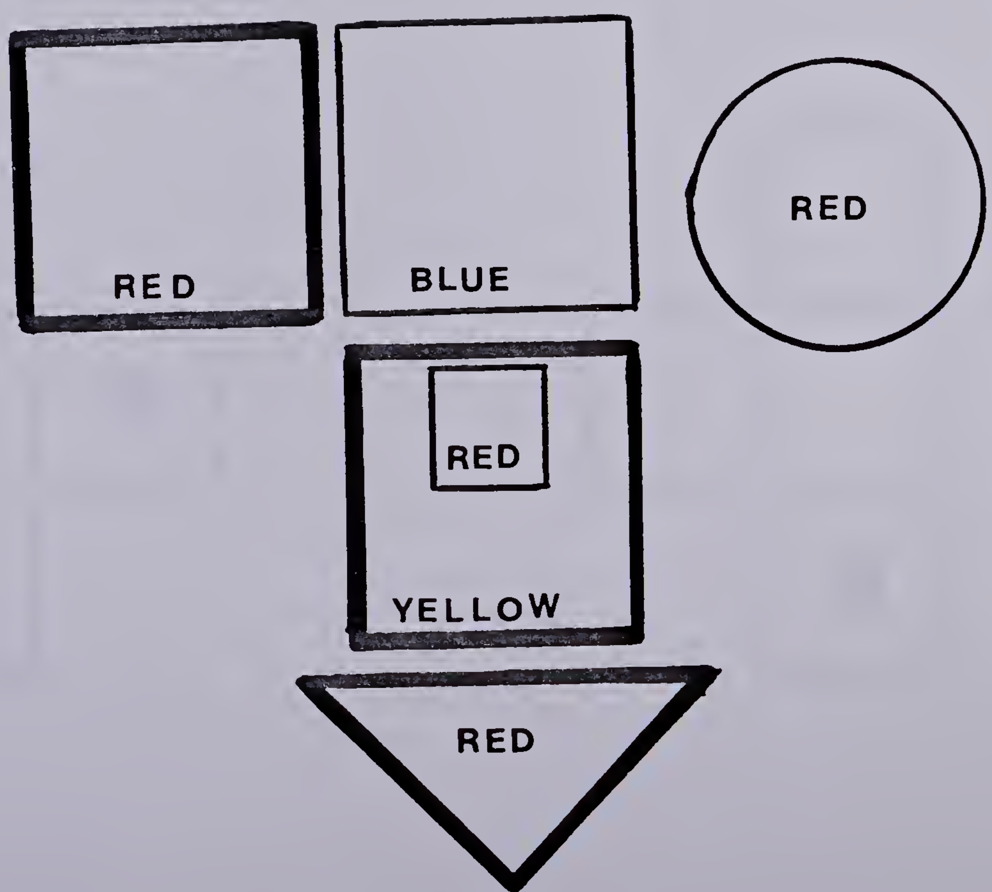
TASK 2: MAGIC WINDOW



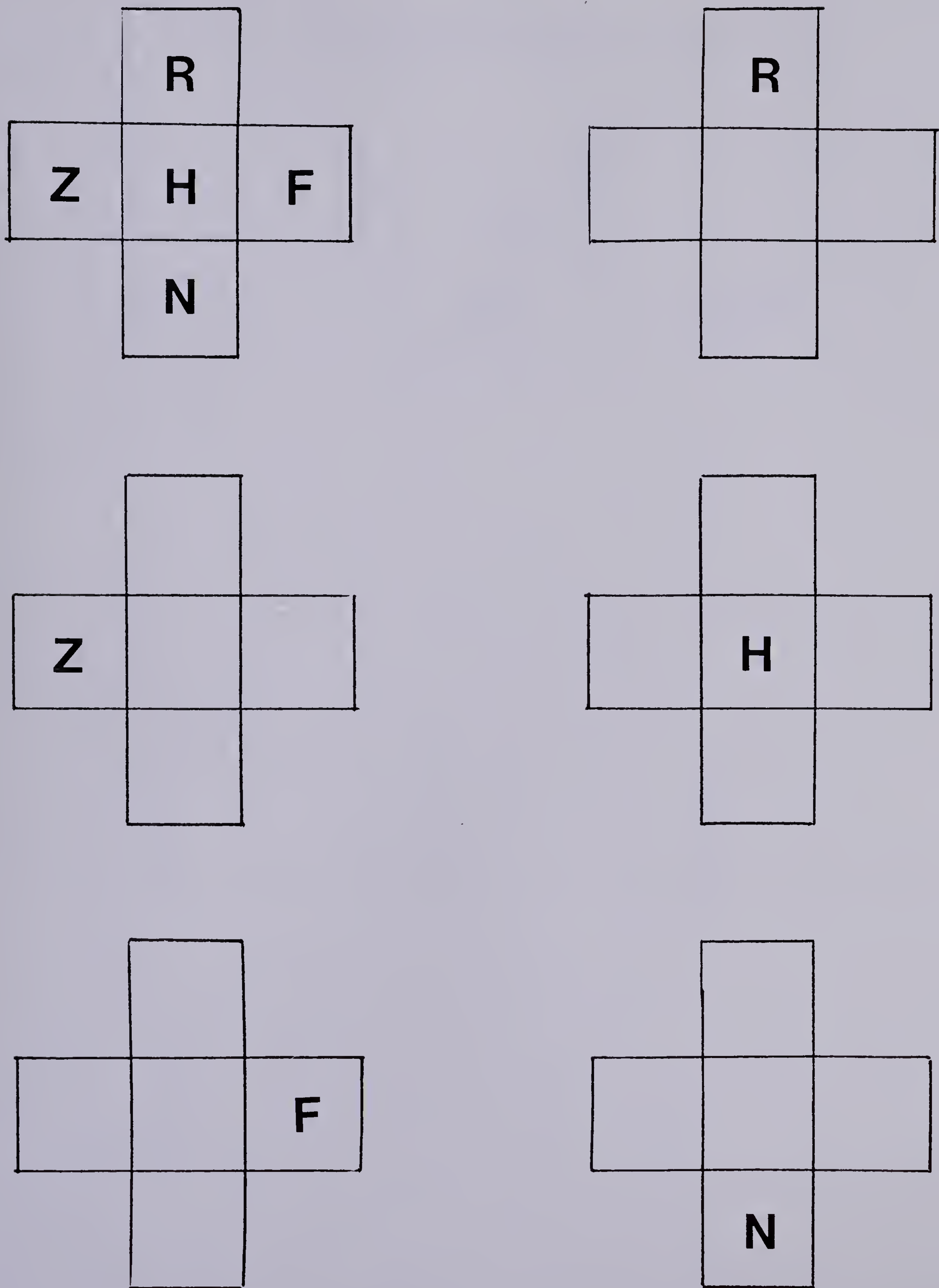


TASK 3 : SHAPE DESIGN





TASK 4: MATRIX LETTERS



TASK 5:MATRIX NUMBERS

	2	
7	9	4
	0	

	2	

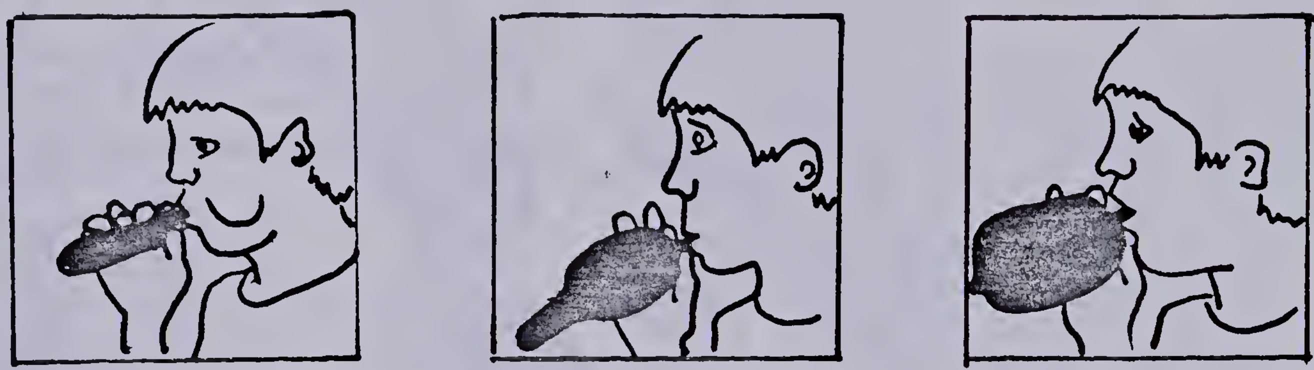
7		

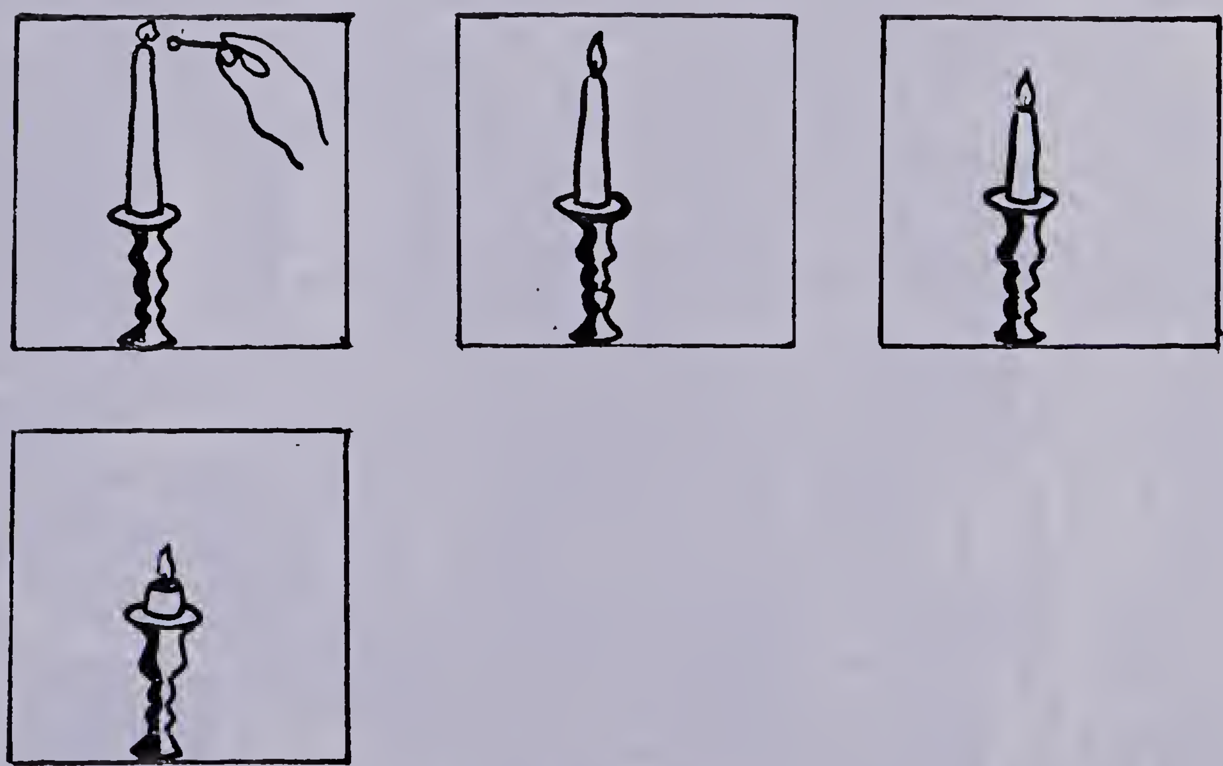
	9	

		4

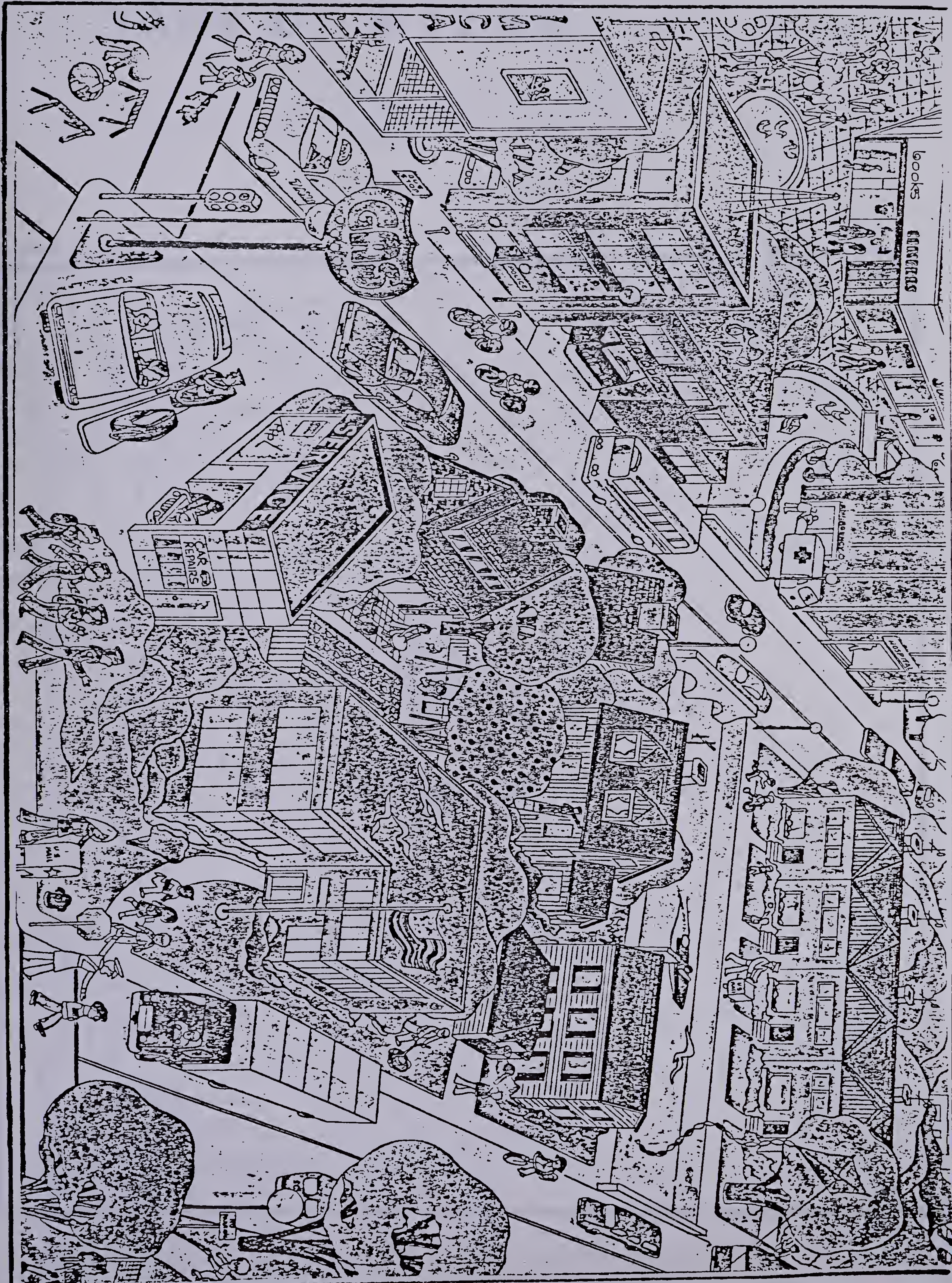
	0	

TASK 6: PICTURE STORY ARRANGEMENT



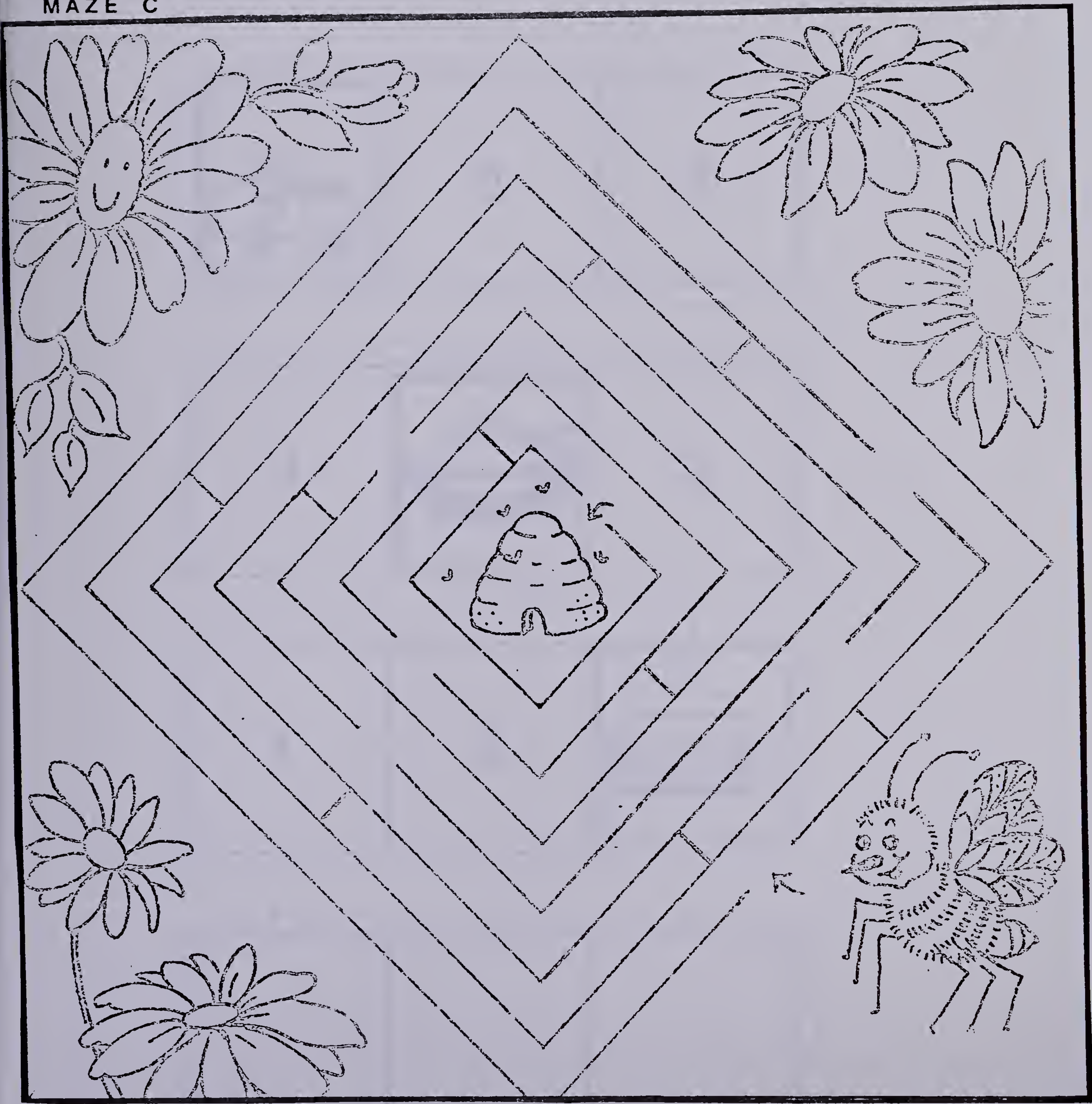


TASK 7 : COMMUNITY PUZZLE

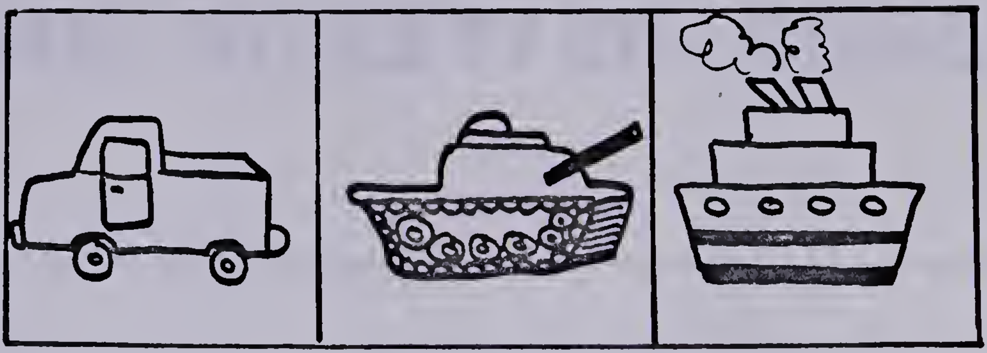


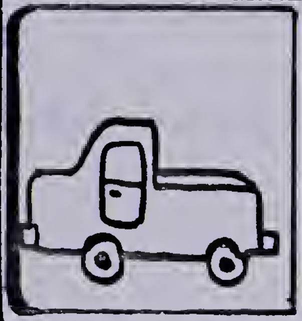
TASK 8 : MAZES

MAZE C

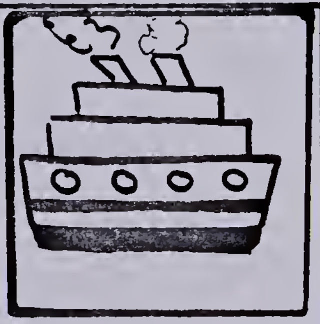


TASK 9: TRANSPORTATION MATRICES



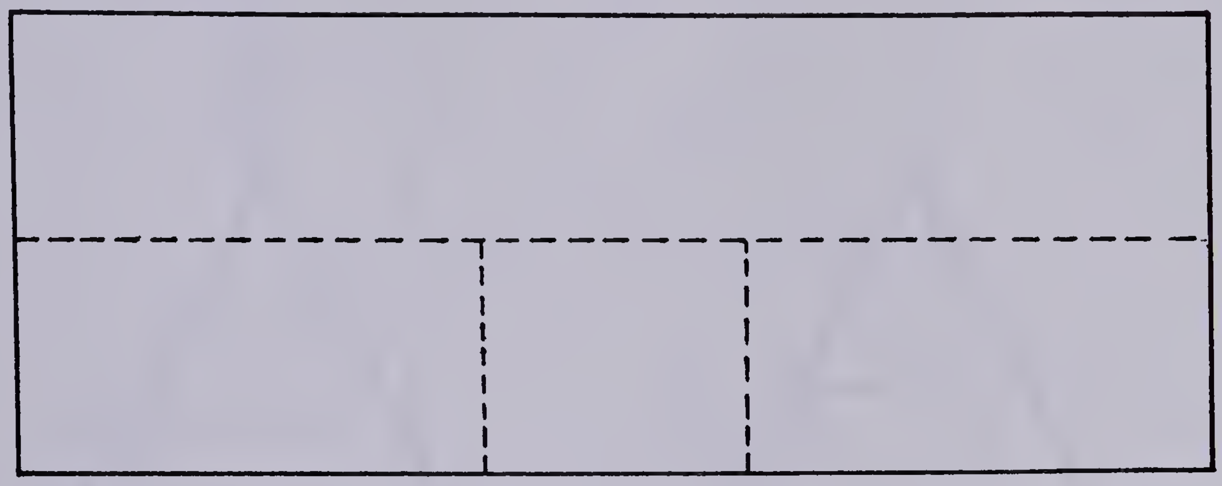
1		
	2	3

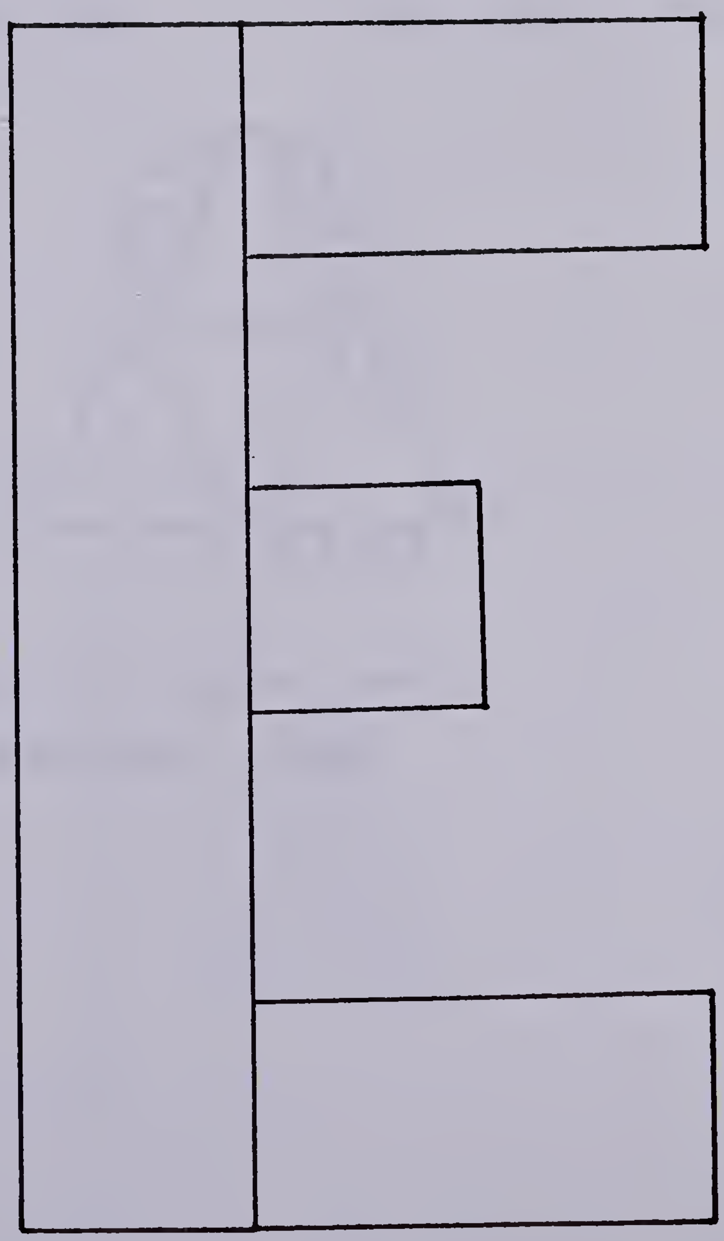
	2	
1		3

		3
1	2	

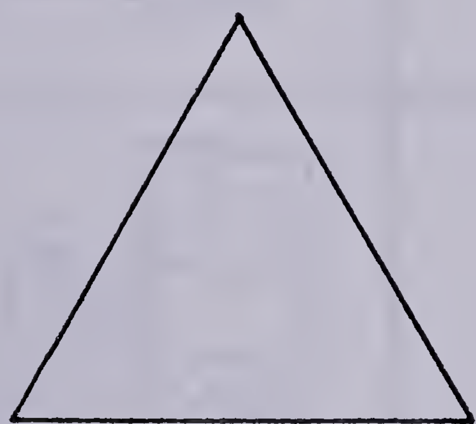
1	2	3

TASK 10: LETTER CONSTRUCTION

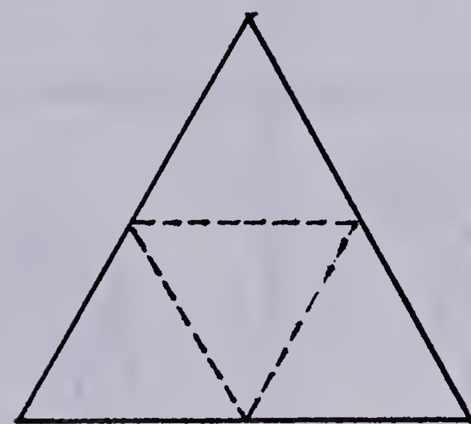




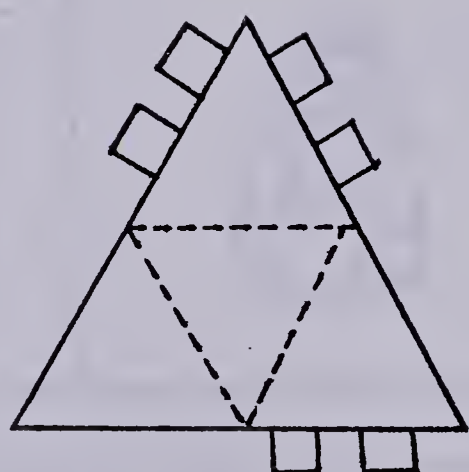
TASK 11: SOLID CONSTRUCTION



STAGE 1: CARD TEMPLATE

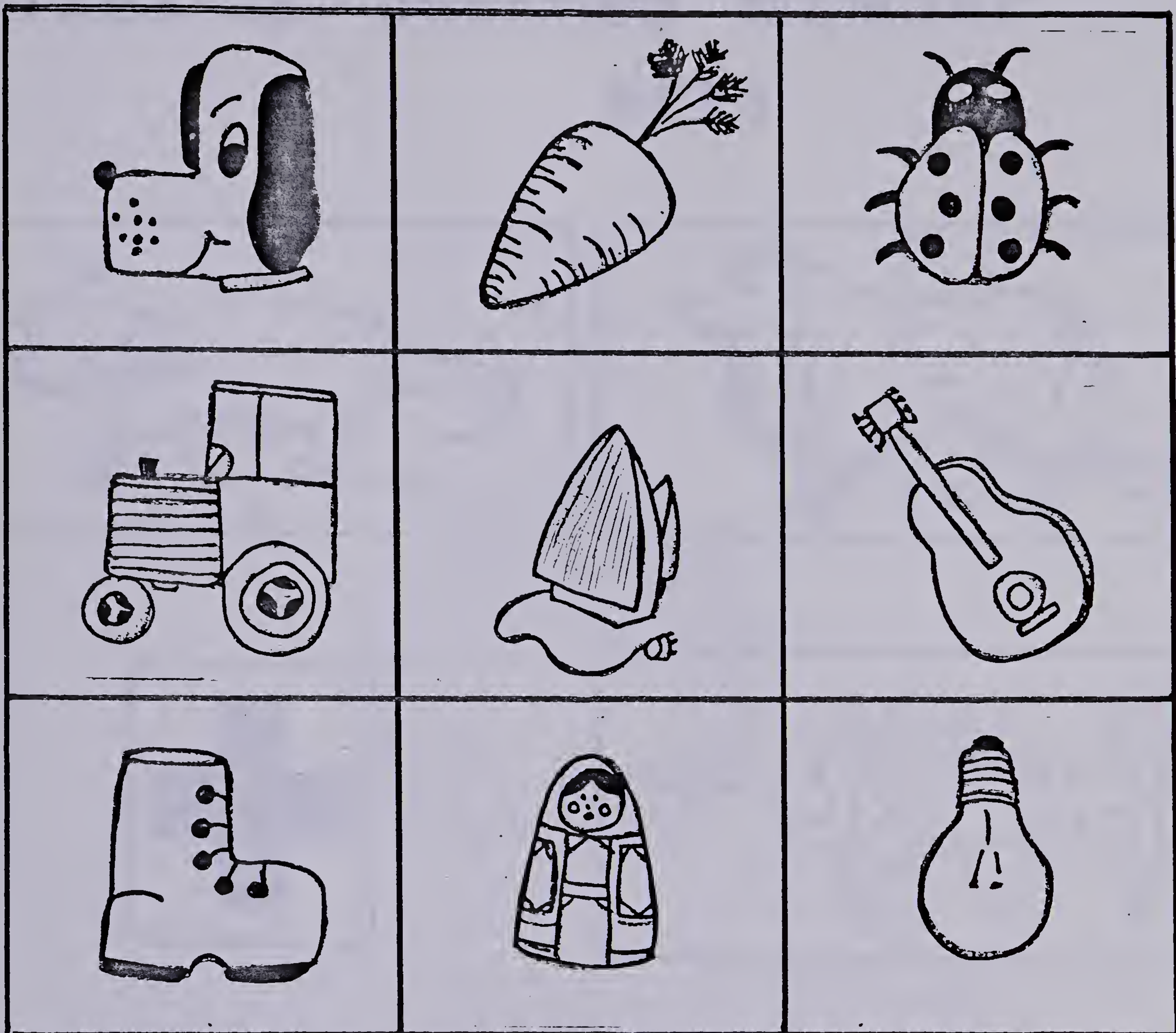


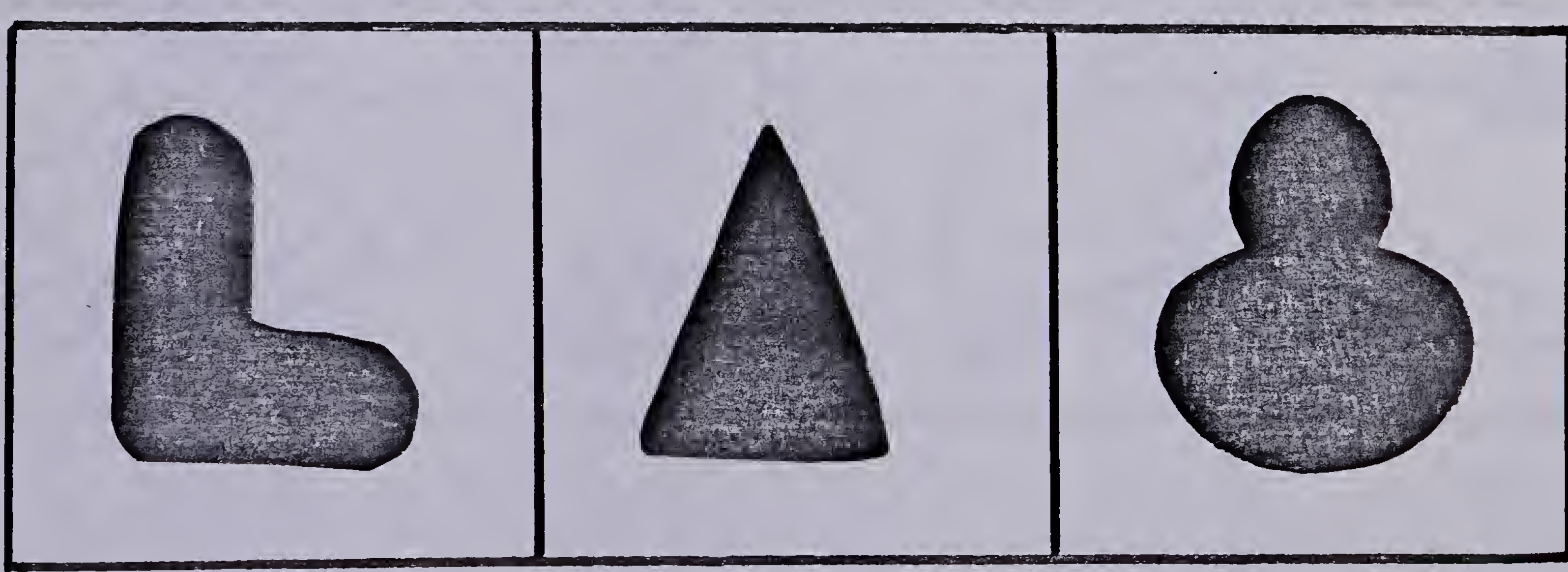
STAGE 2: WHITE CARD WITH FOLD LINES



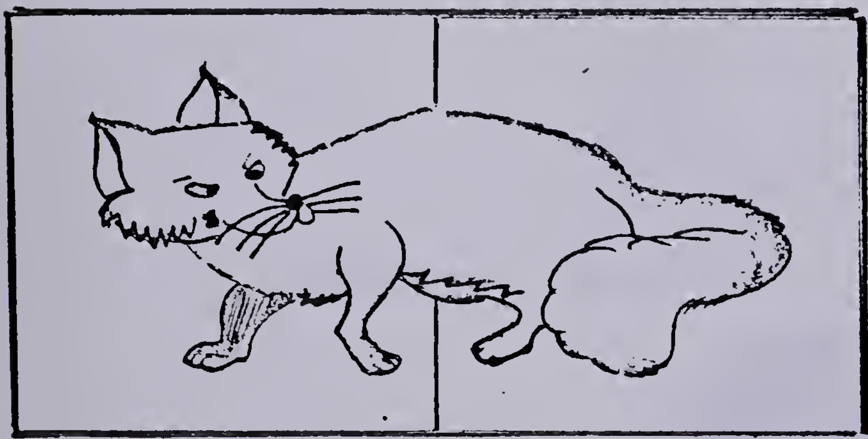
STAGE 3: COPY WITH CONSTRUCTION TABS

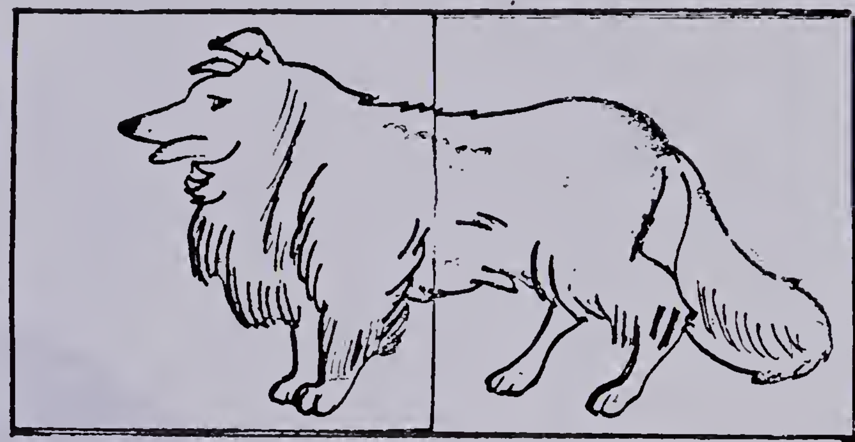
TASK 12: SHAPES AND OBJECTS

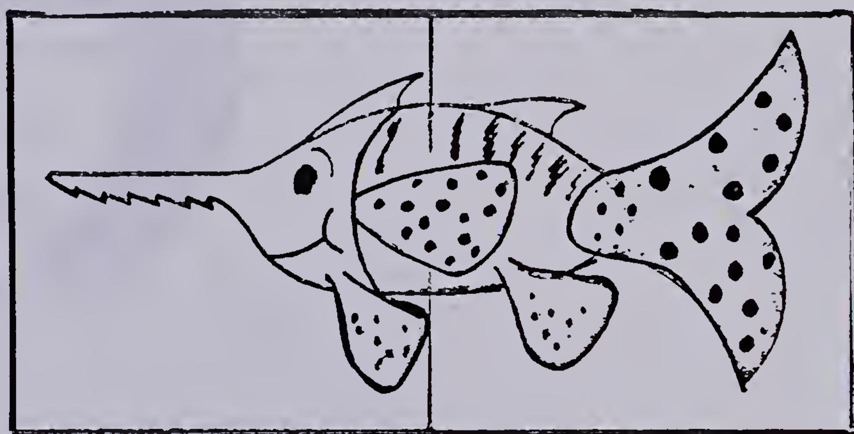


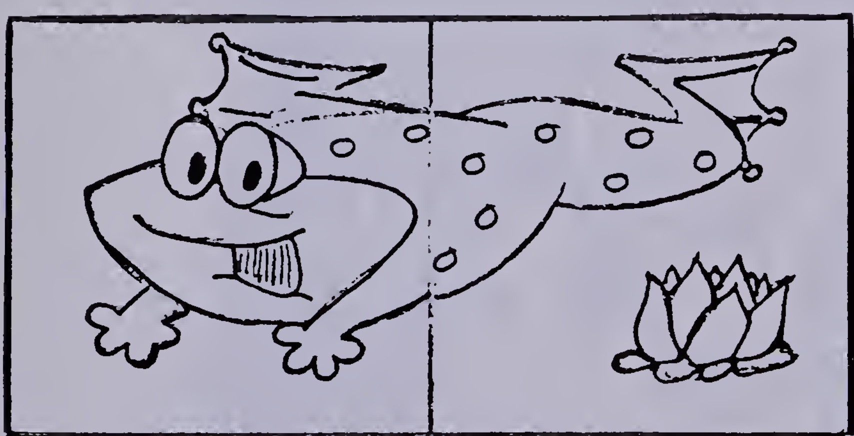


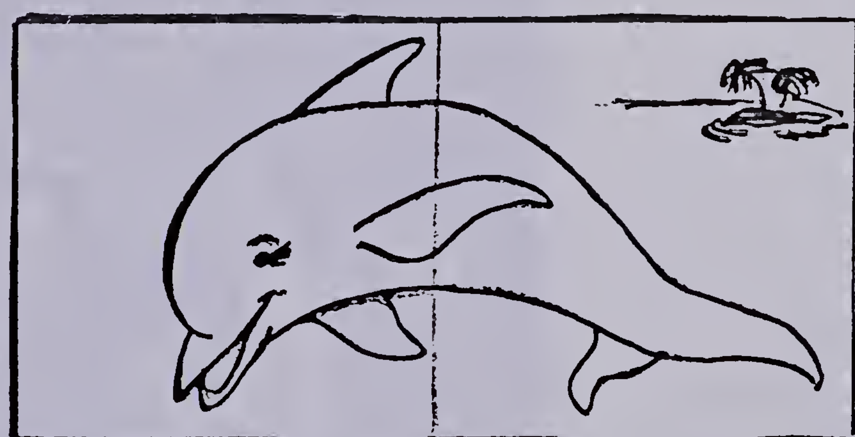
TASK 13: RELATED MEMORY SETS







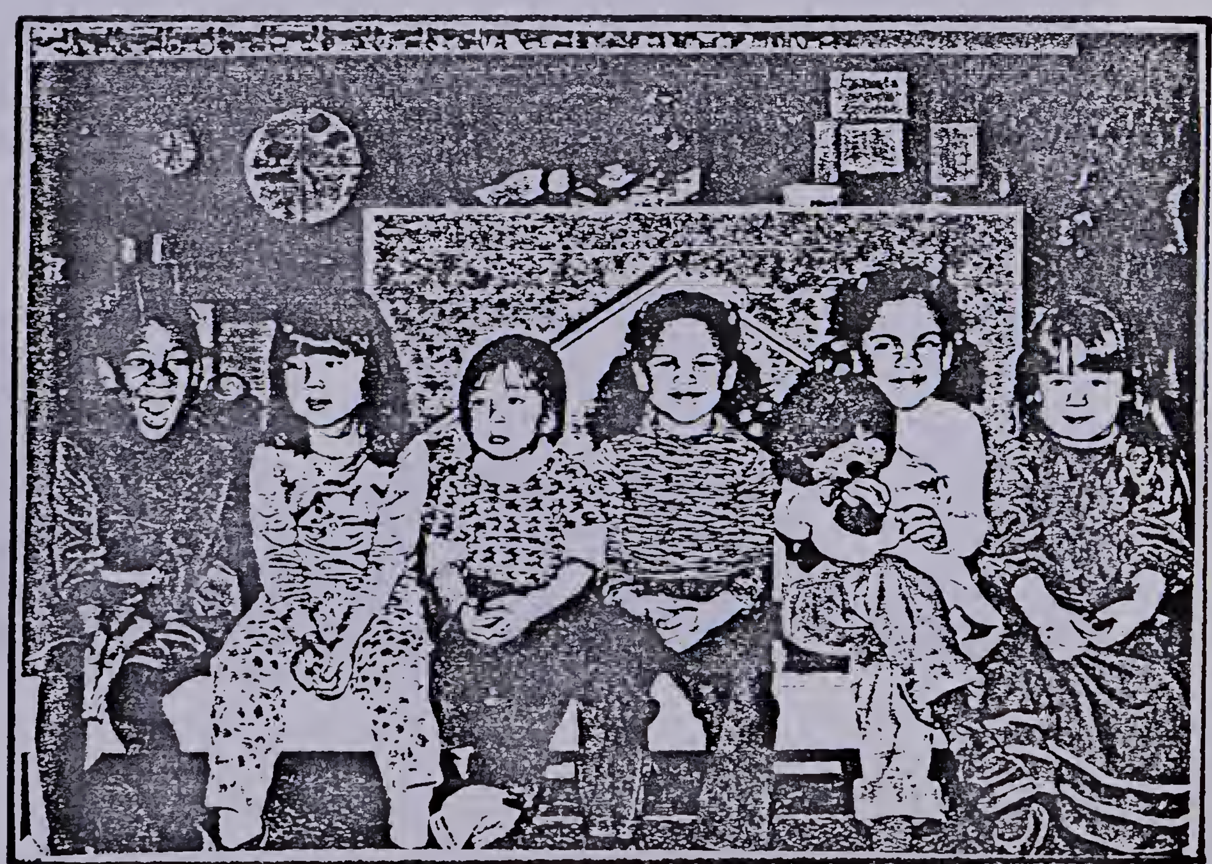




TASK 14: MEMORY FOR FACES

Individual portrait

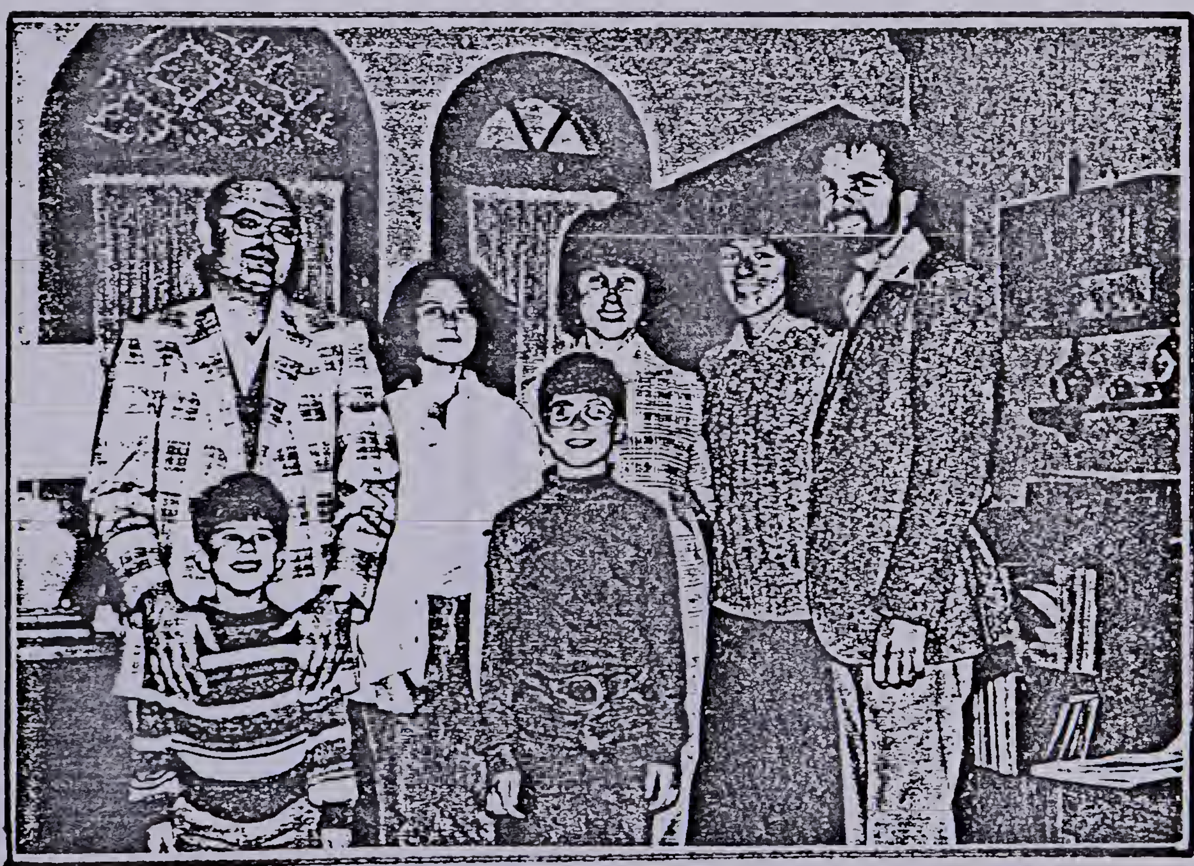
Group photograph



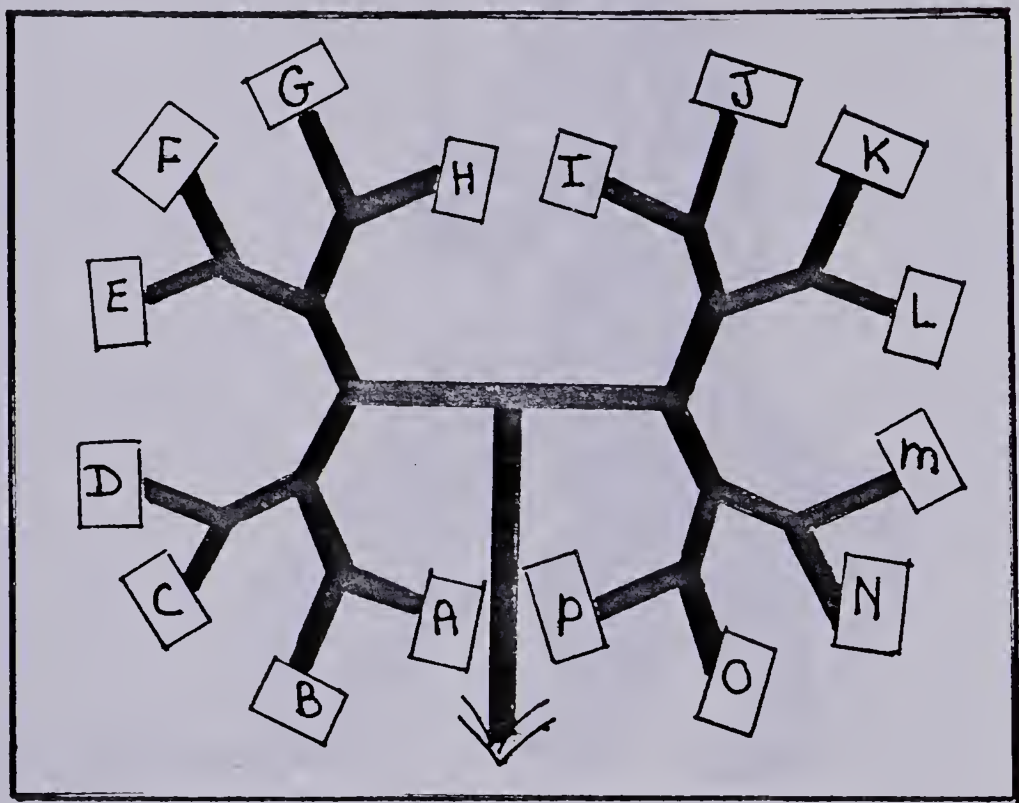
TASK 14: MEMORY FOR FACES

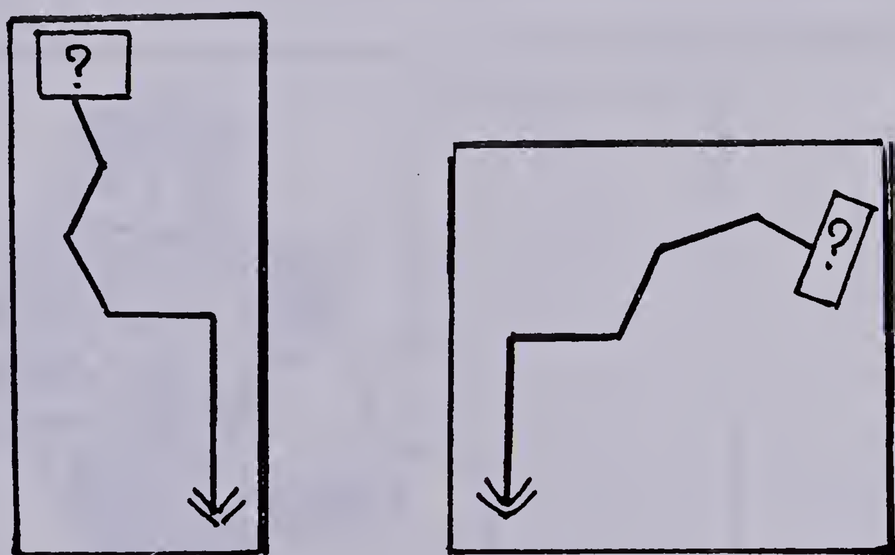
Double portrait

Group photograph



TASK 15: TRACKING II





TRACKING CARDS

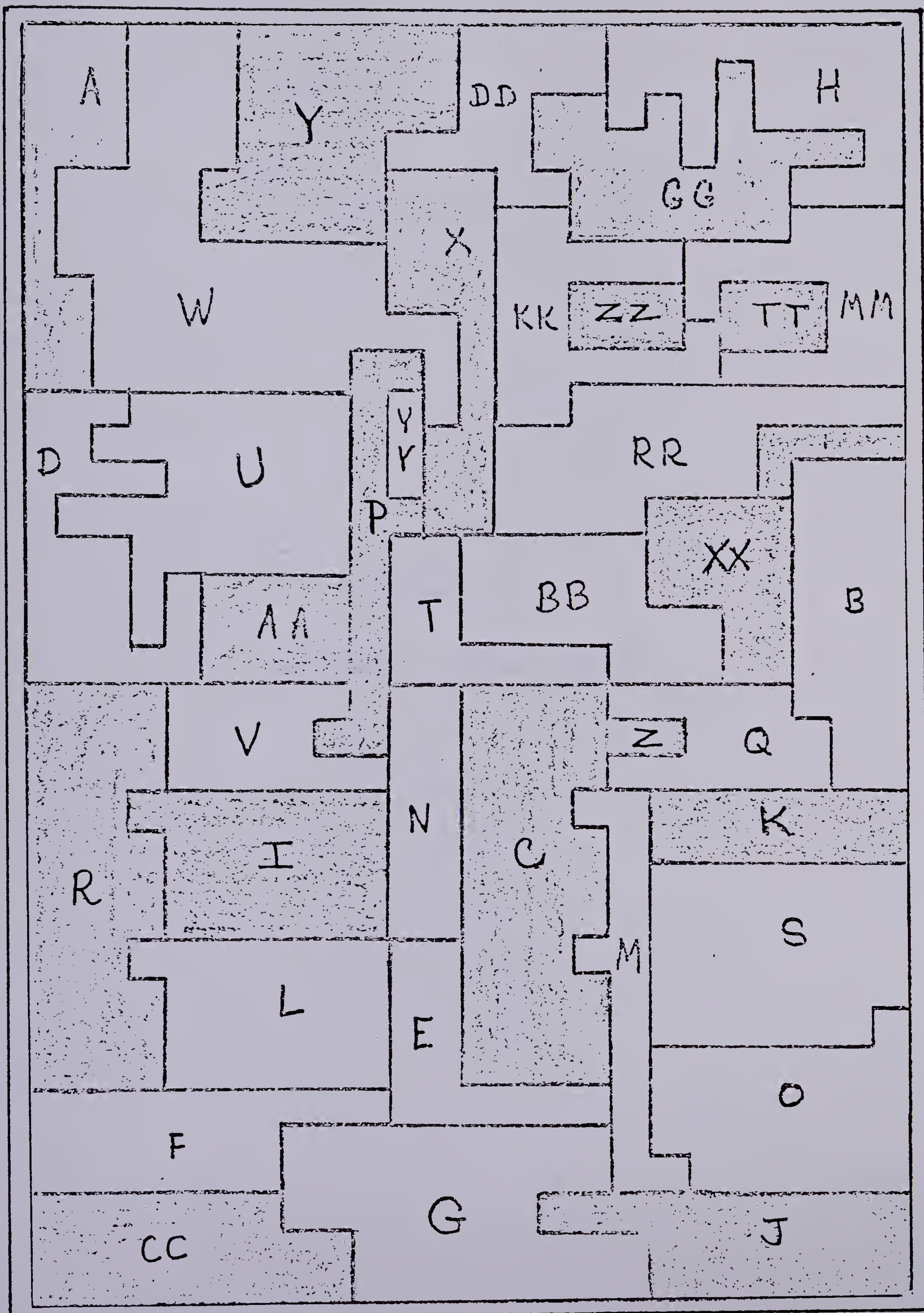
TASK 16: OVERLAPPING PICTURES

Card 1

Card 2

TASK 16 : OVERLAPPING PICTURES

TASK 17: JIGSAW SHAPES



APPENDIX: C

THE TASKS: RECORD SHEETS

Task 1: TRACKING

1a) Where is the house?

CARDS											SPEED	
1	2	3	4	5	6	7	8	9	10	11		
												Trial 1
1	2	3	4	5	6	7	8	9	10	11		
												Trial 2
1	2	3	4	5	6	7	8	9	10	11		
												Trial 3

Child's comments: -

1b) Where is the fir tree?

CARDS											SPEED	
12	13	14	15	16	17	18	19	20	21	22		
												Trial 1
12	13	14	15	16	17	18	19	20	21	22		
												Trial 2
12	13	14	15	16	17	18	19	20	21	22		
												Trial 3

Child's comments: -

Task 2: MAGIC WINDOW

Disc 1	house	ball	tree	gift	block	phone	keys	pig
Disc 2	umbrella	girl	hen	fox	yacht	window	fish	car
Disc 3	bog	leaf	goose	bell	elephant	ruler	pear	boot
Disc 4	gate	watch	snake	scissors	boat	plane	axe	turtle
Disc 5	saw	wagon	bugle	hat	eagle	nail	watering can	apple
Disc 6	book	lamp	table	spoon	bulb	glass	glove	milk

Child's comments: -

Task 3: SHAPE DESIGNS

Set A:

1a.	1b.	1c.
2a.	2b.	2c.
3a.	3b.	3c.
4a.	4b.	4c.
5a.	5b.	5c.

Child's comments: -

Set B:

1a.	1b.	1c.
2a.	2b.	2c.
3a.	3b.	3c.
4a.	4b.	4c.

Child's comments: -

Task 4: MATRIX LETTERS

					Comments
R	Z	H	F	N	
A	S	G	P	Y	
W	M	T	C	E	
C	T	O	A	D	
S	T	P	E	B	
A	H	L	N	U	

Task 5: MATRIX NUMBERS

					Comments
1	5	9	0	7	
4	9	3	5	1	
3	8	0	6	1	
2	7	9	4	0	
1	5	8	6	9	
0	7	5	2	1	

Task 6: PICTURE STORY ARRANGEMENT

A. Sets of 4 Pictures

	Title	Comments
Candle (1)		
Sunset (15)		
River (21)		
Swans (23)		
Balloon (27)		
Apple (6)		
Baby (22)		

B. Sets of 5 Pictures

	Title	Comments
Slide (3)		
Balloon (7)		
Car (13)		
Checkout (14)		
Train (16)		
Dominoes (24)		

Task 6: (con't)

C. Sets of 6 Pictures

	Title	Comments
Sticks (9)		
Egg (11)		
Jam (8)		
Ice Cream (17)		
Milk (4)		
Flag (10)		
Plane (12)		
Rabbit (18)		
Plants (26)		

D. Sets of 7 to 10 Pictures

		Title	Comments
(7)	Boot (20)		
(8)	Cake (2)		
(9)	Hamburger (19)		
(9)	Clown (27)		
(10)	Bookcase (28)		

* Bracket, e.g., Bookcase (28) indicates number of set in Kaufman's Kit (1980).

Task 7: COMMUNITY PUZZLE

A. Building the puzzle.

Trial 1	Trial 2	Trial 3

B. Journey descriptions.

	Comments
1	
2	
3	
4	
5	
6	
7	
8	

Task 8: MAZES

	1	2	3
A →			

	1	2	3
B →			

	1	2	3
C →			

	1	2	3
D →			

	1	2	3
E →			

	1	2	3
F →			

Child's comments: -

Task 9: TRANSPORTATION MATRICES

3: Picture Strips

A	1	2	3
B	1	2	3
C	1	2	3
D	1	2	3

Child's comments: -

6: Picture Matrices

E	1	2	3	4	5	6
F	1	2	3	4	5	6
G	1	2	3	4	5	6
H	1	2	3	4	5	6

Child's comments: -

Task 9: (con't)

9: Picture Matrices

I	1	2	3	4	5	6	7	8	9
J	1	2	3	4	5	6	7	8	9

Child's comments: -

Set 1	1	2	3	4	5	6		
	1	2	3	4	5	6		
Set 2	1	2	3	4	5	6	7	
	1	2	3	4	5	6	7	
Set 3	1	2	3	4	5	6	7	8
	1	2	3	4	5	6	7	8

Child's comments: -

Task 10: LETTER CONSTRUCTION

1 (E)	2 (F)	3 (H)	4 (L or T)	5 (I)

Predicted Letters:

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________

Child's comments: -

Task 11: SOLID CONSTRUCTION

A:

A: Cube			
B: Cone			
C: Cylinder			
D: Pyramid			
E: Rectangular Prism			
F: Triangular Prism			
Solid	Prediction from Template	Prediction from Dotted Lines	Solid Construction

Child's comments: -

Task 11: (con't)

B: Classification of Objects

Solids:

TRIAL
ONE

A	B	C	D	E	F

Time 1: =

Child's comments:-

Solids:

TRIAL
TWO

A	B	C	D	E	F

Time 2: =

Child's comments: -

<u>Task 12</u>: <u>SHAPES AND OBJECTS</u>

Timed Trial 1 = ☐

Score = /15 Comments: -

<u>Child's comments</u>: -

Timed Trial 2 = ☐

Score = /15 Comments: -

<u>Child's comments</u>: -

Timed Trial 3 = ☐

Score = /15 Comments: -

<u>Child's comments</u>: -

Task 13: RELATED MEMORY SETS

Part 1: Prediction and Matching

Child's comments: -

			TITLES			
grasshopper	spider	caterpillar				
pheasant	chicken	parrot				
dog	wolf	fox				
dolphin	frog	swordfish	seal			
chicken	pig	donkey	horse			
cat	cheetah	lion	tiger			
wolf	fox	collie	hound			
mouse	gopher	rabbit	badger			
pig	boar +	cheetah	tiger	lion		
otter	seal +	gopher	badger	rabbit		
parrot	pheasant	robin +	caterpillar	spider		
frog	seal +	collie	hound	wolf		
pony	donkey +	chicken	robin	pheasant		
chicken	thrush	parrot +	collie	fox	wolf	
tiger	lion	cheetah +	grasshopper	caterpillar	spider	
swordfish	seal	dolphin +	gopher	mouse	rabbit	

Task 13: (con't)

fox	wolf	collie	hound +	parrot	robin	pheasant	
spider	grasshopper	caterpillar	+ seal	dolphin	frog	swordfish	
tiger	lion	cat	cheetah	+ collie	hound	wolf	

Child's comments: -

Task 14: MEMORY FOR FACES

Sub-Task 1 (individual portraits)

1	2	3	4	5	6	8	9	12	13	14	16	17	18	19	21	22

Child's comments:-

Sub-Task 2 (identification of two people)

7	10	11	15	20	23
24	25	26	27	28	

Child's comments:-

Task 15: TRACKING II

CARDS	TIME TRIALS		
	TRIAL 1	TRIAL 2	TRIAL 3
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Child's comments: -

Task 16: OVERLAPPING PICTURES

Task 1: (2 piece puzzle)

1a	2a	3a	4a

Task 2: (3 piece puzzle)

6a	8a	10a	5b	7b	9b

Task 3: (4 piece puzzle)

14a	11b	13b	12a

Task 4: (5 piece puzzle)

18a	15b	17b

Task 5: (6 and 7 piece puzzles)

20a (7)	19b (8)

Child's comments: -

Task 17: JIGSAW SHAPES

A	B	C	D	E	F

1. Shape Recognition

Child's comments:-

2. Questions

a) Can B cover CC after one-half turn?

b) Which figure is A flipped over?

c) Which figure looks exactly like R?

d) Which figure could cover H after being flipped over and given a three-quarter turn?

e) Is E like T?

f) Which shape could cover G?

g) Which shape could cover N after a one-quarter turn?

h) Could I cover L?

i) Which figure could cover M after being flipped over?

j) Is V the same shape as Q flipped over?

k) Can you find a shape that is like W flipped over?

l) Is MM a flipped over KK?

m) Find a shape exactly like ZZ.

n) Which figure could cover F after a one-half turn?

Child's comments:-

Task 18: SERIAL RECALL AND ASSOCIATIVE PAIRING OF PICTURES

SET A: (4 pictures)

Axe	Hotdog	Pickaxe	Cake

SET B: (4 pictures)

Boat	Hamburger	Bus	Banana

SET C: (4 pictures)

Grapes	Monkey	Orange	Lion

SET D: (4 pictures)

Boy	Yacht	Girl	Ship

Child's comments:-

SET E: (6 pictures)

Peach	Leaf	Snowflakes	Banana	Tree	Cloud

SET F: (6 pictures)

Apple	Squirrel	Blue Paint	Lettuce	Bird	Blue Engine

SET G: (6 pictures)

Sailboat	Hamburger	Bus	Carrot	Jet	Banana

SET H: (6 pictures)

Desk	Triangle	Truck	Chair	Circle	Car

Child's comments:-

SET I: (8 pictures)

Apple	Pliers	Mouse	Firetruck	Potato	Hammer	Cat	Car

SET J: (8 pictures)

Ice Cream	Chair	Monkey	Gloves	Pie	Table	Tiger	Trousers

SET K: (8 pictures)

Screwdriver	Elephant	Wrench	Dog	Drill	Giraffe	Saw	Rabbit

SET L: (8 pictures)

Cat	Sweater	Apple	Hippo'	Dog	Socks	Carrot	Elephant

Child's comments:-